THE ELECTRICAL WORLD

A Weekly Review of Electrical Affairs

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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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VOL. X. NEW YORK, AUGUST 13 1887. No. 7.

THE meeting of the National Electric Light Association, now being held at Boston as we go to press, is the largest yet assembled by that body, and is, as our New England representative writes, attracting unusual attention. It is now thoroughly realized that the electric lighting industry is on a permanent basis, and has, in fact, larger promise in it than perhaps any other similar business in the country. This point is well brought out by the prominence of the electric motor exhibits, the manufacturers of motors knowing that the electric light circuits offer them the best avenue of introduction. It being the case, therefore, that electric light and electric power are now so well developed and go so well together, we need not wonder at the largeness of the attendance at the Convention. The character and standing of the delegates is also well brought out in the able and exhaustive discussions on the various important topics presented—wire gauges, patent law, new systems of lighting, etc. Recognizing as it has done from the very first convention the importance of these gatherings, THE ELECTRICAL WORLD has made its usual arrangements for receiving the calls of friends and visitors, and it will continue to issue its well-known Bulletin, which has been found so useful at previous conventions in giving, edition by edition, a list of those present, a brief, pithy report of what is done, and a sketch of the exhibits. THE ELECTRICAL WORLD began this Bulletin on its own initiative, and has always published it at its own expense, being sufficiently rewarded in knowing that it has been highly appreciated in all quarters.

BOSTON is well equipped with electric light stations, and the one of which we present a fine illustration this week, is no discredit to the electrical engineering skill within her borders.

OUR Western representative sends this week a list of the bids made for the plant required to light the Chicago River for the city authorities of Chicago. The table goes so much into details that it will be found worthy of special note. The work will not be very easy of execution, but involves some difficult problems.

THE city of Cleveland is getting ready for underground work, so is Buffalo—and so is New York City for that matter, but the rate of progress is painfully slow. The reports from Philadelphia tell of great dissatisfaction there among merchants at the ripping up of the streets. Altogether the indications are that the work of getting the wires underground in any large city will be tediously prolonged. Of course it must go on, but nobody seems to feel any great pride in what has been achieved up to date in the way of comprehensive clearance of wires from city thoroughfares.

ATTENTION was drawn some time ago to the voluntary testimony given by an Austrian gentleman, Herr Friedrich Ross, in Vienna, as to the progress made by electricity in this country. To this we have now to add the opinion of M. Martin, of Paris, who accompanied the gentleman above mentioned. M. Martin publishes his opinion and belief that the reports which reach abroad regarding American enterprise are by no means exaggerated, and that our progress is a substantial and permanent one. Like Herr Ross, he does not approve of all the methods in vogue here, but he gives us credit for the great work we have accomplished in so short a time.

THE terrible fire that has been reported from the Calumet & Hecla mine is one of those casualties to which all mining industries are exposed. The use of electricity for power and light will almost entirely remove the chances of such disasters. Had there in this case been a small electric motor at the level, instead of the steam engine, this accident could not have occurred. To say nothing of the interruption to the vast business interests of the Calumet & Hecla Company, this accident will cost the company more than would be required to completely equip the mine with an electric plant for all uses of power and light which they would require.

IN a recent issue we printed an article in which an investigator sought to prove that the circulation of the blood was maintained by static electric action due to its charge from the atmosphere inhaled by the lungs. This theory, which was worked out with some ingenuity, is at variance with that of another investigator, who has proved that the arterial blood is paramagnetic to the same blood in the venous state. It is the iron contained in the blood which the latter experimenter looks upon as the cause of the motive action of the blood. There is much in these theories which can bear further investigation, but it is significant that nearly all the present students in this field seek the cause in some electrical or kindred action.

THE rapid increase in the number of isolated electric light installations adding storage batteries as regulators and as sources of energy during the stoppage of the dynamos makes the article by Messrs. Braddell and Collins a timely one. The conditions of greatest economy in operation are set forth therein, as well as the best means of obtaining these results. It will be noticed, however, that two of the conditions are somewhat conflicting. Thus, while it is more economical to charge slowly in order to avoid the generation of wasteful heat, the removal of the sulphate of lead formed requires a more rapid rate of charging. The baneful effects of the sulphate, however, are sufficient to call for their removal even at the expense of the energy wasted in the heating of the cell during charge And practice has shown that it is even well to overcharge the cells somewhat for the same purpose—viz., the removal of the sulphate. The best type of machine to employ in the charging of accumulators is shown to be the shunt dynamo, as it obviates the difficulties met with both in the series and compound machine when used for that purpose.

THE evolution of a multipolar dynamo, which tests have shown to give very good results, is well described by the designer himself on another page. Whether or not the theories advanced by Mr. Bradley are correct, the fact remains that their application in his machine has resulted in producing a dynamo in which the weight, both of copper and iron, for the output, is remarkably low. As remarked recently, the tendency at present existing among dynamo constructors is to leave the beaten path of the two-pole machine and to work in the direction of the multipolar. By means of the latter type a rapid change of field is obtained at a speed considerably less than in the former, and this in some respects is an advantage. Thus, as pointed out, a slow-speed motor, running at from three to four hundred revolutions a minute, and exerting from ten to fifteen horse-power, would be specially adapted to electric tram-car service; and a dynamo running at the same speed might be connected directly to the engine, thus doing away with belting. Up to date only the largest sizes of dynamos built have been so connected.

THE induction coil is now employed in connection with many diversified applications, and the difficulties met with in its proper insulation are deserving of notice. Thus the correspondents of a contemporary cite a case in which a coil had been treated in the ordinary way with paraffine wax of low melting point; to increase its bulk for a mechanical reason it was cast in a mold with a harder wax. Previously the coil had given a very good result, but after this treatment it was with difficulty that any spark could be obtained. The experimenters are under the impression that the cooling and contraction of the wax in the interior of the coil after the setting of the harder exterior wax must have left the mass of the wax in the coil full of fissures, which undoubtedly must have been vacua, as no air could penetrate the already hard external coating. To test the accuracy of the aforesaid hypothesis, and, if possible, remedy the defect, they remelted and removed the whole of the harder wax. The spark after this was as good as at first. As all paraffines and waxes of low melting points show this peculiarity, it is evident that their use requires care. For apparatus in which the temperatures are apt to rise much above that of the atmosphere they are not applicable.

IN the second paper of Mr. W. H. Hoffman, which appears this week in the *American Machinist*, the author practically concedes the points raised by us in reference to the almost total displacement of the small steam engine by the electric motor: "The builder of the small and cheap steam engine," writes Mr. Hoffman, "will soon have a very active competitor to meet, viz., electricity. As intimated in the first paper on this subject, he will find the 'subtle fluid' soon carried in protected channels through all large cities, the motive power for this current being triple expansion steam engines that will easily produce a horse power with a consumption of less than 1¼ pounds of coal per hour. The electric companies can and will cover all cases of small powers, say from 1 to 17 horse-power, at this very low fuel consumption, within a short time, if we take the progress made in this new business within the last six months as our guide." While the use of powers ranging as high as 17 h. p. is thus thought to be the limit for the electric motor, it may well be questioned whether the future will not demonstrate the economy of drawing far greater powers from central electric stations. Motor builders are designing larger and larger types in the sizes of their machines for stationary purposes, and some of the best informed men in this field of work assert that as much as 100 h. p. can be economically drawn from an electric central station for one consumer.

THE English papers are to hand giving full reports of the dinner held in London recently to celebrate the jubilee of the telegraph there. We have already printed a special cable dispatch on this subject, and now find that the whole proceedings were, as then indicated, of a most interesting nature. The advance of America in matters telegraphic was more than once alluded to in the speeches, especially by Sir William Thomson, who took occasion to refer with much felicity to the work of Joseph Henry and Cyrus Field, and who recalled the time when Mr. Field, with "American spring, life and energy, flashed across the Atlantic" to secure English assistance in carrying out his great project. The cable dispatch forwarded by Mr. George G. Ward to the celebrants we have already published, and we now give that of General Eckert, who quoted some striking figures as to the extent and efficiency of the Western Union system, whose wires would girdle the earth nineteen times. The organizers of the dinner are to be congratulated upon its success, and, further, upon having thus drawn public attention in England to the great strides made in electrical science and application. As Sir William Thomson pointed out, the rate of transmission between England and Dublin is ten times what it was ten years ago, and although that may not be a particularly conclusive reason why Ireland should not have a Parliament of her own, it is something for the inventors and telegraphers who do the work to be proud of.

Boston Meeting of the National Electric Light Association.

FROM OUR REGULAR CORRESPONDENT.

BOSTON, Mass., Aug. 8, 1887.—There is every indication at the present time of writing that the attendance at the National Electric Light Convention at the Parker House, this city, will be larger than has marked any previous meeting. The industry has been growing rapidly during the last two years, but it has not developed more rapidly than the general interest in the subject. It will be remembered also that this is the first time that New England has been favored as a location for the convention, yet probably there is more activity and more capital in this section, in the electric light and electric power business, than in any other of equal size and population. Boston itself can show as fine stations and as successful management as any other place, and she is also the centre of large electric manufacturing interests.

While the deliberations of the convention are likely to occupy a large share of attention, it is certain that the special exhibits are going to be unusually large and attractive. Among the exhibitors will be the Baxter Motor Company, of Baltimore, Md., which will have a number of its motors in operation. The co-operation of several manufacturers in Boston has been secured, and Baxter motors will be operated in connection with the following: B. F. Sturtevant, steel pressure blower; Blackman ventilating fan; alternating dynamo for incandescent light; standard button machine; Wheeler & Wilson, vamping machine; Clark cord machine, topstitching machine, front and backstaying machines; Wilcox & Gibbs, lining machine; Jordan & Marsh, shirt machine; Tarbett & Kelley's printing press; American Tool and Machine Company's dynamo lifter and starter, and Charles L. Ireson's self-adjusting leather link belting machine.

The Sprague motor will also be seen in operation, as well it should, in a city where it has scored some of its most notable successes. The C. & C. motor is also, I hear, to be well displayed, and the Cleveland motor is to demonstrate its efficiency and excellence.

The Thomson-Houston Electric Company will make a large exhibit of its apparatus for arc and incandescent lighting and also its new electric motor which you lately illustrated.

The Sun Electric Company, of Woburn, Mass.; Bernstein Electric Light Manufacturing Company, of Boston; Schaefer Electric Manufacturing Company, of Cambridgeport, and Edison Electric and Illuminating Company, of Boston, will demonstrate the distinctive methods of their systems of incandescent lighting. The Billings & Spencer Company, of Hartford, will exhibit samples of copper drop forgings. The Wainwright Manufacturing Company will present its feed water heater. The Standard Electric Time Company, of New Haven, will show its novel electrical gauges. The Scovill Manufacturing Company will exhibit its silicon bronze wire. There will also be a good display of electric glass ware.

The Executive Committee has already been hard at work, so that, what with the early arrivals, the work being done by the exhibitors to get into shape, and the general bustle, the convention is making itself felt even to-day before it meets.

W. I. B.

The Tamine Accumulator.

M. Tamine, of Brussels, has devised an accumulator of the Planté type, in which the liquid consists of a saturated solution of sulphate of zinc, to which is added 50 per cent. of sulphuric acid, 5 per cent. of sulphate of ammonia and 5 per cent. of sulphate of mercury. In making up the cell it is stated that the ingredients should be poured in in the reverse order to that here enumerated. The E. M. F. of the cell is given as 2.3 volts. The addition of sulphates of mercury and ammonia is said to prevent the formation of sulphate of lead on open circuit.

Callender Installations.—The Callender Insulating and Waterproofing Company has received the contract for the underground work on the Edison stations at Columbus, O., and Grand Rapids, Mich., where all the feeders are to be buried, the "solid system" being used. The company are also making cable feeders for the new Edison station at Washington. These cables are to be pulled into conduits, and are extremely large, some of them having a diameter of just 2½ inches.

Sothern's Messenger Arrested.—The New York district messenger boy sent to England by E. H. Sothern with souvenirs of "The Highest Bidder" for distribution among that actor's friends, has been arrested in London for a violation of the postal laws, which do not allow such service to be performed, all mail delivery being a monopoly of the Postmaster-General. The boy will now be more a hero than ever, and there is no doubt that Americans in London will "see him through."

Regulation of Incandescent Lamps by Secondary Batteries and Charging of the Same.

BY W. FORMAN COLLINS AND ALFRED E. BRADDELL.

Secondary batteries will act as very efficient regulators when coupled in parallel with incandescent lamps, and the fluctuations in the light due to the irregularities of driving, etc., can be completely overcome by their use, provided certain conditions are maintained; among these we have first, the internal resistance of the cells, which must be very low compared with the external resistance; secondly, the difference of potential at the terminals of

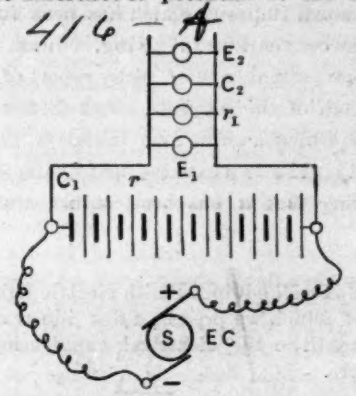


FIG. 1.

the charging dynamo must be kept above the counter electromotive force of the cells. This can be shown mathematically in the following manner:

In the diagram, Fig. 1, let

S = the resistance of the charging dynamo;
E = the difference of potential at its terminals;
C = the total current given out by the dynamo;
r = the internal resistance of the cells;
E_1 = the counter E. M. F. of the cells;
C_1 = the current in the cells;
r_1 = resistance of external circuit;
E_2 = difference of potential at lamp terminals;
C_2 = current in external circuit.

Now by Kirchhoff's laws we obtain:

$$C_2 = \frac{E r + E_1 S}{S(r + r_1) + r r_1}.$$

Now if the internal resistance of the cells is low compared with the external circuit, we may write:

$$C_2 = \frac{E_1 S}{r_1 S}$$

$$\therefore C_2 = \frac{E_1}{r_1};$$

but by Ohm's law

$$C_2 = \frac{E_2}{r_1}$$

$$\therefore E_1 = E_2.$$

Or, the back E. M. F. of the accumulators, which is a constant quantity, is equal to the difference of potential at the lamp terminals.

Hence, the advantages of using secondary batteries in connection with isolated incandescent plants are, perfect steadiness in the light, and the dynamo and engine need not be run continuously. The capital outlay is necessarily greater, but is more than balanced by these advantages.

Accumulators may be charged with a series, shunt or compound dynamo, but for this purpose a shunt machine is greatly superior, as will be seen from the following considerations. In charging secondary batteries with a series wound machine, the first difficulty encountered is in starting; for, owing to the counter E. M. F. of the cells, which is really equivalent to a very high resistance,

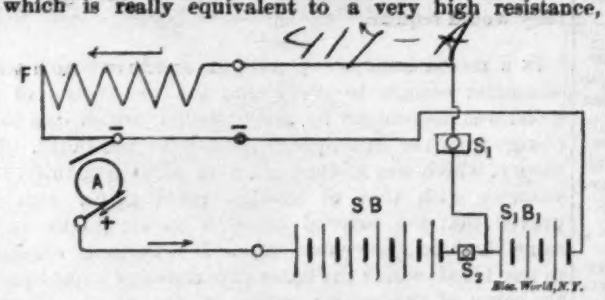


FIG. 2.

if the machine be switched directly onto the cells, no current would be obtained through them. This may be overcome by first exciting the machine on a low resistance, in order to get up its terminal difference of potential sufficiently and then switching the cells into circuit before this low resistance is switched out, so that the machine is at no time on an open circuit. When the cells are in circuit, the low resistance is removed. An ordinary broad contact switch may be used for this purpose.

Now as the cells become nearly charged, their counter E. M. F. rises, and if allowed to become equal to the E. M. F. of the dynamo, instead of more current flowing into the cells it flows back into the machine, and reverses the poles of the field magnets, and also the poles of the armature, at the same time tending to reverse the machine and run it as a motor. This would destroy the brushes, and the abnormally large current due to the cells being on so low a resistance as the machine, would tend to destroy the insulation of field magnet and armature coils.

If no automatic device is used to cut out the cells when this state of affairs is reached, the ammeters must be carefully watched, and directly the deflection falls the cells must be cut out. Before starting to charge again, if a reversal has taken place, the poles of the machine must be reversed, for the positive pole of the machine must always be connected with the anode (or positive pole) of the cells. Automatic switches may be used to disconnect the circuit. Another method which may be employed when charging with a series machine, is to keep a few cells on the field magnets; this effectually prevents reversal. The connection would be as shown in the diagram Fig. 2.

In Fig. 2 let F be the field magnet coils; A the armature of the machine; S_1 and S_2 switches; $S\,B$ and $S_1\,B_1$ be the secondary batteries; D a dectector which shows the direction of the current in the field magnet coils.

To start charging S_1 must be switched on first; then S_2. By this means, the current always flows in the same direction in the field magnets, and, therefore, the poles of the machine cannot be reversed, provided the cells are properly balanced.

In charging with a shunt machine, there is no difficulty in starting, provided the machine gives sufficient E. M. F., for it will excite itself on its shunt coil; also, there is no liability of the machine reversing its direction of rotation, even if the cells do reverse. If the cells reverse, the poles of the armature are reversed, and the dynamo will tend to run as a motor in the same direction with the brushes, whilst the poles of the field will remain the same. In charging with a compound machine, the direction of rotation, if a reversal occurs, will depend on the relative strength of the shunt and series coils.

This shows that the shunt wound machine is the most advantageous to use in charging secondary batteries.

With regard to the rate of charge, the energy employed is expended in two ways. First, in producing heat in overcoming the internal resistance of the cells. Now, this will depend on the square of the current, and hence upon the rate. Also in heat caused by the E. M. F. of contact. Second, in producing the chemical action which occurs when the electrolyte is decomposed. Now, as the heat produced in overcoming the resistance of the cells varies as the rate, it would appear to be most economical to charge as slowly as possible. In practice there is always a certain amount of local action between the support and its covering of peroxide. To overcome this and reduce the lead sulphate, which is always present, a higher rate of charge must be employed. When the cells are at rest there is always a tendency towards the formation of the white sulphate of lead; for, peroxide being a good conductor, easily gives up its oxygen, and since it is in contact with the support, a local action goes on in the following manner:

$$Pb + PbO_2 + H_2SO_4 = PbO + PbSO_4 + H_2O.$$

Wherever the anode is exposed to the acid, when the cells are idle, lead sulphate is formed, which, being a non-conductor, tends to separate the lead support and the peroxide. Hence, a higher E. M. F. is required to start cells that have not been charged for some time. Now, this sulphate has to be reduced to peroxide, and, therefore, we must charge at such a rate as to effectually reduce this sulphate and bring down the resistance of the cells to their normal amount. Hence, we must not charge too slowly, for the above reasons, nor too fast, for then the plates will buckle and the losses due to heating will be too great. The general rate adopted is from 2 to 3 ampères per square foot of plate surface.

Dr. O. Frolich on Dynamos

Dr. Frölich, writing in the *Elektrotechnische Zeitschrift*, gives some measurements upon the increase in the impedance (resistance due to self-induction) of the armature of a Siemens D_2 machine with increasing velocity of rotation. The armature resistance measured 0.3 ohms. When mounted in a wooden frame, and run at 1,100 revolutions, the impedance was 0.911 ohm; while, when in position in the machine, the impedance amounted to no less than 3.62 ohms, the difference being, of course, due to the increased magnetization of the core. Dr. Frölich makes the remark that the coefficient at a given velocity is independent of the position of the brushes, and also of the magnetic intensity of the armature field (current in armature). This, however, merely shows that the machine was working on the horizontal part of the characteristic. He adds that in the machine used as a motor there is some variation which requires further investigation—a conclusion at which several other investigators have arrived. The chief discrepancy is undoubtedly due to the fact, pointed out by Mr. Mordey, of the different relations of the Foucault currents in the two cases; but this does not seem to cover the whole of the ground. Dr. Frölich, in conclusion, advances the opinion that the characteristic curve of a machine is not the end of the theoretical discussion, but rather the beginning, and gives a solution of only a few points required, and by no means an insight into the behavior of the machine; and to the "knights of the characteristic" he propounds the following proposition: Given, for a simple shunt-wound machine in which the armature exerts considerable reflex action, a series of experimental observations with different external resistances and velocities; required, the electrical qualities of the machine dem-

onstrated in such a manner as to give a sufficiently accurate solution without special difficulty, and at the same time an insight into its internal economy.

The Ferdinand Street Station of the Boston Electric Light Company.

The handsome three-story brick building, with its towering smoke-stack, the most prominent object of attraction to any one glancing up Ferdinand street from Columbus avenue, in Boston, is one of the four stations of the Boston Electric Light Company.

The building was finished in April, 1885. Its dimensions are 50 × 110 feet, with a boiler-house adjoining covering a plot 60 × 80 feet. The lower floor of the main building is occupied as an engine room, in which are situated five Armington & Sims automatic cut-off (high speed) engines of 150 h. p. each. In addition to these there are two Fitchburg slow speed engines, one of 250 h. p. and the other, a vertical engine, of 50 h. p. The engine room also contains two Deane steam pumps, one power pump, and a Locke Bros.' steam damper regulator. Each engine is belted direct to a separate shaft 13 feet long, and each shaft has four pulleys, which drive the dynamo machines on the floor above.

The offices are just off the engine rooms, separated only by a partition, nearly all of which is composed of sliding windows, thus enabling the occupants of the office to keep a constant outlook on all parts of the engine room.

Up one flight of stairs is the dynamo room, shown in the accompanying engraving. It contains 26 machines, as follows: 23 Brush dynamos—16 of 65 arc-lights and 7 of 30 arc-lights capacity; also 3 Thomson-Houston dynamos—2 of 30 and 1 of 50 arc-lights capacity. This makes the total lighting capacity of the station 1,360 lights, nearly all of which are now in actual use nightly. This department is amply equipped with switch-boards, ampère meters, and all the apparatus requisite about a first-class and well-regulated electric light station.

The upper floor is used as a lamp and stock room, and the visitor to this department is momentarily impressed with the idea that he is in an extensive fixture and glass-globe wareroom.

The station is supplied with an elevator capable of lifting four tons. In the boiler house, which opens into the engine room by a large archway, are five Cunningham boilers and three Whittier boilers, each of 125 horse-power. These boilers are set with the Jarvis patent furnace and the Sheffield grate bar for burning screenings. There are also two National feed water heaters of 600 h. p. each, from the works of the National Pipe Bending Company. The entire steam plant was installed by the Jarvis Engineering Company, of Boston and New York, and that concern has been the recipient of complimentary letters from electric light people in all sections of the country for this creditable piece of work.

Mr. Patrick Fahey is the superintendent of all the stations of the Boston Electric Light Company, which are as follows: Ferdinand Street station, formerly owned by the Brush Elecric Light Company; the Congress Street station, formerly owned by the Merchants' Electric Light and Power Company; the Stanhope Street station, formerly owned by the Weston Electric and Illuminating Company; and the East Boston (Condor street) station, formerly owned by the Citizens' Electric Light and Power Company.

Mr. Fahey makes his headquarters at the offices of the first-named station, devoting a portion of each day to each station, and in his duties in this line he is assisted by Mr. John O'Neil, on whose counsels and experience the former gentleman greatly relies. Mr. Fahey has been connected with the present company and its predecessor (the Brush Electric Light Company) since the commencement of electric light operations in Boston in 1881. The other gentleman above referred to, Mr. John O'Neil, has been in the employ of this company and its predecessor for more than seven years. It is to Mr. O'Neil's credit that the Ferdinand street station was erected after plans and specifications drafted by him. He had full charge of the laying out of the foundations of the building and boiler house and superintended the erection of both; after the completion of these, the equipment of the engine-room and dynamo department was also left entirely to his judgment and discretion. His conscientious work has naturally gained him the confidence and good will of the company. The fine switch-board in the dynamo department of this station is also the result of his labor, and it is an evidence of electrical ability and mechanical skill. The present position filled by Mr. O'Neil is that of chief engineer and assistant to Mr. Fahey.

The other officers of the company are as follows: F. A. Gilbert, president; Hugh O'Brien, vice-president; S. S. Sias, secretary and treasurer.

The employés of the company at the four stations and at the executive offices, corner of State and Devonshire streets, number one hundred and twenty-five.

When the predecessor of the Boston Electric Light Company first started business in April, 1881, it had only three arc-lights in operation, one on Green street and two on Court street. The officers of the company at that time were: Wm. D. Forbes, president; James Sturgis, treasurer, and Samuel S. Sias, secretary. Six or eight months afterward Mr. Sturgis resigned and the Hon. Hugh O'Brien (now the mayor of Boston) was elected to the position of treasurer, which post he filled with credit to himself and to the advancement of the company's best interests, until the recent consolidation of all the electric lighting companies in Boston. Mr. O'Brien then declined the treasurership offered under the new régime, owing to the multiplicity of his other business duties, but accepted the vice-presidency of the consolidated companies.

The business of the Brush Electric Light Company kept steadily growing, until, on December 31, 1886, it had in actual operation upward of 900 arc-lights, with a lighting capacity at the Ferdinand street station of 1,200 arc-lights and about 2,000 incandescents.

Since the date of the consolidation, the number of arc-lights of the company at the station described has been increased to 1,360. The company's incandescent lights, not taken from the arc-light circuits, are to-day principally furnished from the Stanhope street station.

1276—A

FERDINAND STREET STATION, BOSTON ELECTRIC LIGHT COMPANY, BOSTON, MASS.

Cure of Naso-Pharyngeal Tumor by Electrolysis.

At the last meeting of the American Laryngological Association, Dr. Rufus P. Lincoln, of this city, described a case of a tumor which had been removed by electrolysis. The patient presented himself in April, 1886. A growth of had been removed from the posterior nares by another physician one year previously. It returned, and the operation was repeated six months later. When the patient came under observation he was unable to breathe through the left nostril. On examination, a large growth was found occupying the left half of the posterior nares, and it was decided to treat this by electrolysis. On June 3, two needles connected with the negative pole of the battery were introduced through the anterior nares into the growth, while the positive pole terminated in two large sponge-electrodes which were applied to the front and back of the chest. In all sixteen applications were made, at intervals of three or four days. This caused an entire disappearance of the growth. The immediate effect of the electrolysis was to cause distention and a change in the color of the growth, but these passed off in the course of twenty-four hours. There is up to the present time no evidence of turn of the growth.

The McIntire Wire Joint.

It has long been recognized that in order to obtain good results in telegraph and telephone work the joints in the line wires must be such as to insure absolute metallic contact at all times. The mere twist alone, which was employed at first, was found inadequate, and soldered joints were resorted to. What is true of the telegraph and telephone has been found still more manifest in wiring for electric lighting. While in the first two cases a defective joint means bad service, in the latter it may mean overheating at that point and danger from fire. Hence, in

FIGS. 1 AND 5.—MCINTIRE WIRE JOINTS.

electric light wiring, especially, the soldered joint was the only one which had up to a recent date been permitted.

The soldering of joints, however, is a tedious process where a large number of lamps are to be wired for, and presents other inconveniences. In order to do away with the necessity for soldering, and still secure perfect metallic contact in wires coming together, Mr. Charles McIntire, of Newark, N. J., has brought out a method of joining wires by which perfect contact is maintained without the use of solder.

In order to accomplish this, Mr. McIntire makes use of the device shown in Fig. 1. This consists merely of two short lengths of brass or copper tubing brazed together so as to form one piece. Into these tubes the ends of the wires to be joined are inserted, as shown in Fig. 2. The tubes are then gripped by vises, as clearly shown in Fig. 3, and twisted until they present the appearance shown in Fig. 4.

During the twisting operation, it will be noticed that the length of the enclosing tubes and wire has been decreased, and by the sliding process which has taken place the two surfaces have been brought into close contact with each other. This is proved by the fact that upon slitting the tube open after it has been twisted the surface of the wire and the interior wall of the tube are found to be polished bright by the friction which has taken place between the two surfaces. The ends of the tubes and wire also show that the contact is a most intimate one and that no moisture or dust can enter between the joint.

By this simple means wires of any desired size up to No. 0000 can be joined with ease and certainty, and wires

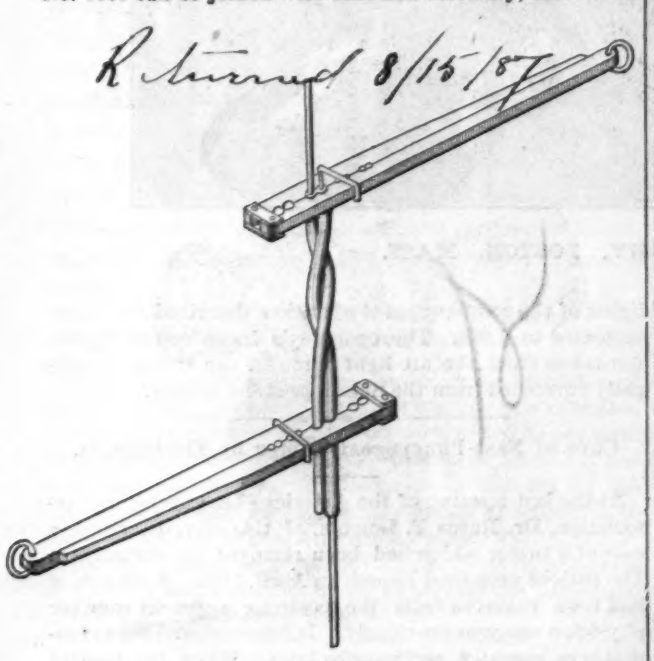


FIG. 3.

of different sizes can be joined by tubes of varying diameter, as shown in Fig. 5.

For very small sizes of wire it has been found that it is not even necessary to twist the joint; but by merely compressing the tubes at different points, by means of a pair of nippers, a perfect "compress" contact is obtained.

The advantages of this form of joint are evident. It has been adopted in the work of the prominent electric light companies, and a large number of long distance telephone lines and telegraph lines of hard drawn copper are equipped with it throughout.

The Uphill Work of the Electrical Pioneer.

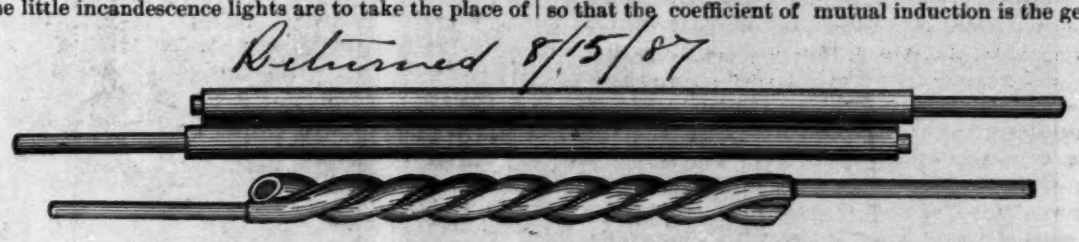
From the wonderful strides made in the introduction of electrical apparatus, it might be inferred that such apparatus had not encountered the slightest opposition anywhere, but had been welcomed as freely by those who had vested interests in something else as by the general public. Yet nothing could be further from the fact; and the history of the success of the electric light and the electric motor—the latest applications—is that of one long fight—a record of the survival of the fittest. Instances of the opposition that has had to be met could be given by the score by electric light men, and can be found in quarters where one would least expect them. The triumph and popularity of the electric light to-day, after several years of the most strenuous endeavor to keep it back and put it out, is well exemplified in an editorial article published by the *Scientific American* last week.

In October, 1885, our contemporary asserted in a leading article: "The business of the voltaic arc light companies may be said to furnish additional evidence of the credulity of human nature," and, it added, "large quantities of lighting plant are manufactured for those provincial projectors who are possessed of robust bank accounts and adamantine credulity." We protested against such language at the time, and only recall it now, because the *Scientific American* has changed its opinions entirely and has the frankness and manliness to avow its present conviction. It devotes more than a column to the National Electric Light convention, and sketches the growth of the Association, pointing out the adverse and re-trictive influences. Then as to the light, it says: "To-day the principal squares and thoroughfares of the metropolis are lighted by it, and there is serious talk of doing away with the gas lamps. It girdles the city, and stretches in a long chain of light across a continent. *Yet not a complaint is heard.* Every considerable city or town in the country is either lighted by it or is considering the subject. Almost every great building going up has the two little wires protruding out of the walls in a hundred places, showing that the little incandescence lights are to take the place of gas." Such is, indeed, the case, and when we add that the gas companies are themselves as eager as anybody to install the electric light, the picture is complete.

So much for one battlefield. Another is opening up, however, in the fight now being made against the electric motor. Last week we gave some figures to show how the stationary motor for industrial purposes is gaining ground, and on a number of occasions we have cited the statistics of electric railways. It would, indeed, seem that the fact that there *are* electric railways in this country was one pretty widely known, but that such is not the case is proved by the publication of the following editorial in the *National Car Builder* for the current month:

"In the course of an interesting article on Electric Street Railways in Europe, an English contemporary deplores in lengthened terms the red tape methods pursued in Great Britain in connection with the introduction of new enterprises, and to that restricting influence is attributed the slow progress made in introducing electric railways into the British Isles. The article says that in the United States electric tramways are successfully at work in many of the larger cities, and that preparations are going on in America to widely extend this method of traction. This looks as if we must go abroad to hear the news. We have for some time been searching large and small cities in America for an electric street railway in successful operation, but we have not yet been able to find one. There are numerous rumors to be heard of electric tramways running successfully, but when they are chased up they prove a veritable will o' the wisp. This season has been noted for a remarkable extension of street railways in the United States, and a large mileage of cable has been put down for operating street railways, and there is no difficulty in locating the cities where the 'grip' is making headway, but we can not definitely locate any of the much-talked of electric street railways."

Though not desiring to propose a policy for any contemporary, we will remark that it is the duty of a technical paper before printing such an article as that, to satisfy itself that there is warrant for it. The article has simply been written, we are sorry to say, without the least effort to ascertain the truth. We beg to inform our contemporary that there *are* electric railways *to be found without much trouble* at Detroit, Mich. (2); Windsor, Can.; Appleton, Wis.; Scranton, Pa.; Denver, Col.; Los Angeles, Cal.; Baltimore, Md.; Montgomery, Ala.; Kansas City, Mo.; Binghamton, N. Y.; Lima, O.; Port Huron, Mich., and Gratiot, Mich. Roads are now building at San Francisco; Woonsocket, R. I.; Pittsburgh, Pa.; Mansfield, O.; Asbury Park, N. J.; Richmond, Va.; St. Catherines, Ont., and other places. Roads are under contract for New York City; Ansonia, Conn.; Wilmington, Del.; St. Joseph, Mo.; Lakeville, O.; Harrisburg, Pa.; Dayton, O.; Allegheny, Pa.; Belleville, Pa.; San José, Cal.; San Diego, Cal., and elsewhere. Companies have been formed to build electric roads, and may of them are now negotiating for the work of construction at Muncie, Ind.; Ontario, Cal.; Eureka, Cal.; Lincoln, Neb.; Flushing, N. Y.; Findlay, O.: Middletown, Conn.; Wichita, Kan.; Winston, N. C.; New Brunswick, N. J.; Bayonne, N. J.; Birmingham, Ala.; Jacksonville, Fla.; Brooklyn, N. Y.; Boston, Mass.; Cambridge, Mass.; Newton, Mass., and other places; while roads are seriously projected at Atlanta, Ga.; Fort Smith, Ark.; Plainfield, N. J.; Scranton, Pa.; Newton, Kan.; Rockaway, N. Y.; Coney Island; Butte, Mont.; Port Chester, N. Y.; Pelham Park, N. Y.; Orange, N. J. (partly built); Chicopee, Mass.; Wooster, O.; Reading, Pa., and many other places. An electric road is running admirably in the East Boston Sugar Refinery; another has gone into operation in the Lykens Valley coal mines, Pennsylvania, and storage cars have been shown in successful operation in New York and Philadelphia. This looks as though there was just a little movement in electric railway matters that would naturally arrest the attention of an ordinarily acute observer; but all we will insist on is the admission as to the roads given in our first list. A journal that has the rank and standing of the *National Car-Builder*, ought to be more careful in thus dismissing with contempt or passing in ignorance the early successes of a growing industry. But it is the old fight over again.



FIGS. 2 AND 4.—McINTIRE WIRE JOINTS.

Note on Transformers for Electric Distribution.*

BY PROF. SYLVANUS P. THOMPSON.

In the simple algebraic treatment of the dynamo several assumptions approximately true for well-made machines are made use of. The author finds that a similar set of assumptions for transformers greatly simplifies the algebraic theory.

1. The iron, copper, and insulation are assumed good. 2. The reaction of the secondary on the primary (other than that desired) is small. Thus, if the primary be supposed to be supplied with constant mean current or constant mean potential difference, this is not to be altered by the current in the secondary. 3. No magnetic leakage; so that the coefficient of mutual induction is the geometric mean between their coefficients of self-induction. 4. The quantities of copper in the primary and secondary are to be equal. These assumptions are shown to be legitimate, and the ratio of resistances, E. M. F.'s, currents, and coefficients of self-induction are expressed in terms of the ratio of the numbers of convolutions, which ratio is represented by $p = \frac{S_1}{S_2}$. From analogy with the dynamo it is shown that

$$E_2 = \frac{\omega M}{\sqrt{R_1^2 + \omega L_1^2}} E_1$$

where $\omega = 2\pi n$, E_1 and E_2 the E. M. F.'s of the primary and secondary respectively, and R_1 and L_1 the resistance and self-induction of the primary coil. If R_1 be negligible the above reduces

to $E_2 = \frac{\omega M}{\sqrt{\omega^2 L_1^2}} = \frac{E_1}{p}$, since $\frac{L_1}{L_2} = p^2$ and $M = \sqrt{L_1 L_2}$.

The latter part of the paper contains a general investigation of two neighboring circuits, both having self-induction, and it is shown that the effective resistance of the primary is increased, and the self-induction decreased by closing the secondary circuit.

At Prof. Thompson's request Prof. Ayrton exhibited a lecture experiment illustrating the action of transformers. The secondaries of two ordinary induction coils were joined in series through long fine wires, and an incandescent lamp placed in the primary circuit of one, lighted up on completing the primary of the other coil in which a battery was placed.

Street Cars in Philadelphia.—The complete success of the trial trip of an electric motor car on the Spruce and Pine Street Railway yesterday possibly marks a new era for street railroading in this city. The preliminary difficulties seem to have been met and overcome, and if the single question of cost is satisfactory, stored electricity as a motor is likely to displace both the use of horses and the cable system in Philadelphia. The substitution of some more efficient means for propelling street cars than the slow, costly and cruel method now most in vogue seems certain to come soon. Humanity, if nothing else, ought to bring this about. The sufferings of street car horses in the heat of summer and during the storms of winter ought to touch the hardest heart, but unfortunately trade does not take into account the sufferings of dumb beasts, provided the balance is on the right side of the ledger. It is only by showing that there will be a larger balance on that side that a substitution of mechanical force for horse flesh will be made. Let us hope that that time is near, and that by the progress in invention the sympathies of the humane will no longer be excited by the tugging and straining under the goad of so useful and intelligent an animal as the horse.—*Philadelphia Press.*

* Abstract of paper read before the London Physical Society.

Hammer's Electric Circuit Tester or Polarity Indicator.

The electrician in practical work is frequently obliged to know the direction of flow of the current, and this is especially manifest in the Edison central station work. In placing the Edison meters on the two or three wire system, it is essential to test for polarity or direction of flow, as the current must always pass in one direction. Such tests are also essential in making connections, repairs and alterations in the underground or overhead system. They are also

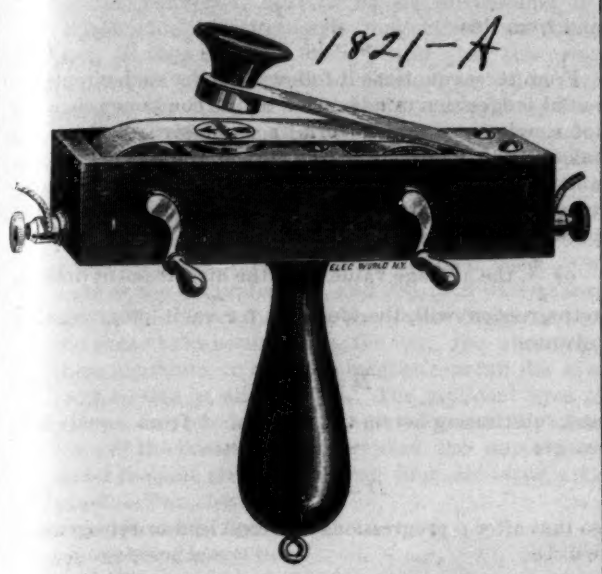


FIG. 1.—HAMMER'S CIRCUIT TESTER.

necessary in setting up, connecting and testing dynamos, motors, storage batteries, etc., and indeed are in frequent demand in nearly all electric installations.

The means heretofore employed to test polarity or direction of the current have, as a rule, been crude, and entailed loss of time, and hence, in order to make this test both simple and expeditious, Mr. Wm. J. Hammer, manager of the Boston Edison station, has recently devised a portable instrument of novel construction.

The apparatus, shown in perspective in Fig. 1 and in section Fig. 2, consists of an ebonite block provided with a handle; within the block are placed two reels for winding and unwinding a long strip of bibulous paper saturated with a solution of one of the cyanides of potassium, preferably the ferri-cyanide, which may be made more sensitive by the addition of a little chloride of lime, or common salt.

The strip of paper connecting the two reels passes over a metallic button which is connected to the binding post at the front end of the apparatus. Suspended above the button is a small iron stamp marked with an arrow in the centre of a circle, across which is printed the word "positive." This iron stamp is attached to the end of a spring and surmounted by an ebonite button, the other end of the spring being electrically connected with a binding post at the opposite end of the apparatus. To these two binding posts are attached two flexible wires which may be attached to the circuit to be tested.

Now, if the direction of flow of the current is from the binding post at the rear end of the spring, by striking the ebonite button a slight blow, so that the stamp is brought in contact with the paper, a circle containing an arrow pointing in that direction with the word "positive" printed across it will be printed thereon in dark blue, indicating that the terminal referred to is positive, and that the tendency of flow, so to speak, is from that direction. Should there be no mark made upon the upper surface of the paper, this would prove that it is the negative pole of the conductor.

The reels, though small, still contain a large reserve of

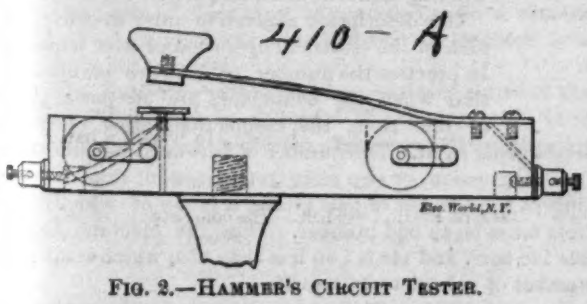


FIG. 2.—HAMMER'S CIRCUIT TESTER.

test paper, which should be slightly moist, and this apparatus hanging up in the station is always ready for use, and is calculated to save much time and trouble when tests of polarity are necessary, as they are constantly.

Mr. Edison has carried out an exhaustive series of experiments in connection with his chemical printing telegraphs, chemical recorders, etc., and has discovered a large number of solutions which give red, crimson, green, blue, black and other colors, some at the positive pole and others at the negative. He has found that the legibility, permanency, color, and polarity of the markings may be varied not only by the employment of different chemicals, but also by varying the metals employed at the points of contact with the sensitized paper.

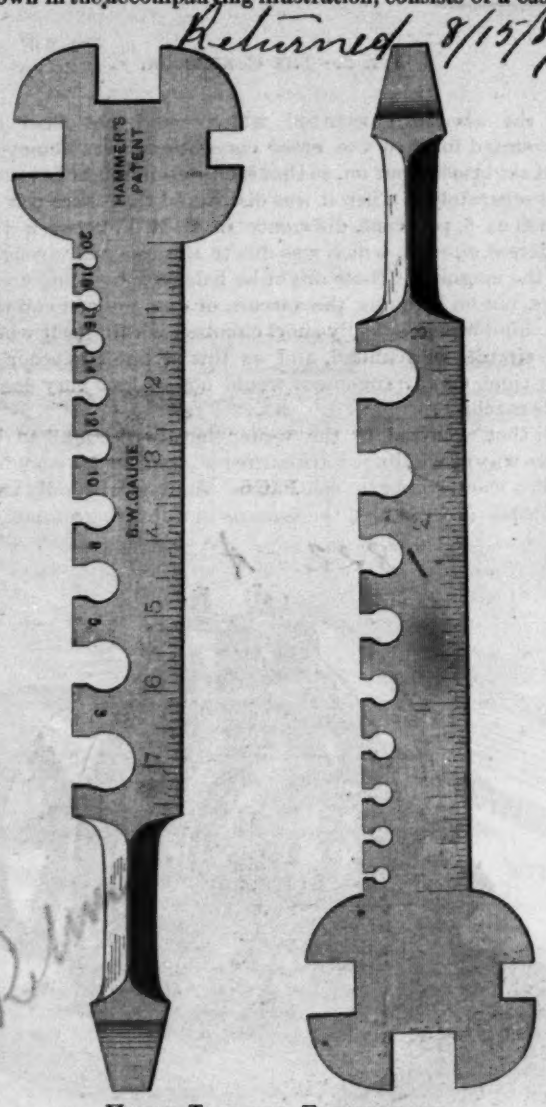
An Electrician's Pocket Tool.

The various implements which the practical electrician requires almost constantly in his work have been well assembled in the combination tool designed by Mr. Wm. J. Hammer, of Boston, and shown in two views in the accompanying illustrations. The tool includes a screw-driver; a wire cleaner or pencil sharpener; a Birmingham wire-gauge ranging from No. 3 to No. 20; a comparative scale of English inches and French millimetres, and a combination wrench.

This neat little tool is made of the finest tool steel, properly tempered and made with very great exactness. The wire-gauges are made either of the Birmingham or Edison Standard sizes. The English and French scales of measurements are on opposite sides of the tool, and can be readily compared. The tool is enclosed in a neat leathern or card-board case, and is of a convenient size to carry in the vest pocket. It is needless to say that this useful tool will meet with approval among electricians generally.

The Baker Automatic Governor.

When incandescent lamps are placed in multiple series on arc light circuits, it becomes necessary to provide means by which the extinction of a lamp is followed by the insertion of an equivalent resistance in order to prevent the destruction of the remaining lamps. A form of apparatus recently devised for that purpose is the automatic governor of Mr. C. D. Baker, the electrician of the Baker Electric Company, of Chicago. This apparatus, which is shown in the accompanying illustration, consists of a case,

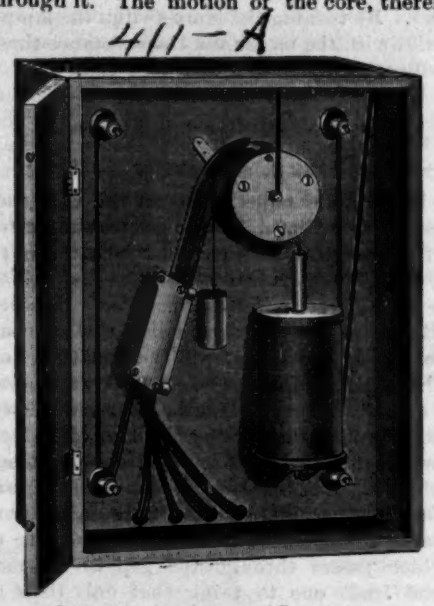


HANDY TOOL FOR ELECTRICIANS.

in the front compartment of which the regulating mechanism is situated, the resistance for maintaining constant potential at the incandescent lamps being in the rear.

The regulation is effected by the solenoid shown, in which a movable core is placed and held in equilibrium by a counterweight connected to it by a cord passing over a pulley. The solenoid is compound wound, the coarse wire carrying the main arc current, while the fine wire winding of high resistance is placed in shunt to the incandescent lamps. The action of these two coils is to hold the core in a balanced position. The current passing through the coarse wire being constant, it follows that any change in the incandescent circuit would disturb the balance and cause the armature within the solenoid to be either more strongly attracted, or vice versa. This will cause it to move one way or the other, transmitting motion to the pulley, which acts as a commutator. The pulley carries at its periphery a rolling metallic contact, which makes and breaks contact with one or more of the resistances placed in the rear. The counterweight balances the weight of the core in the solenoid, and is heavy enough to give the coarse wire some percentage of strength over the fine, and by the adjustment of this weight the desired amount of candle-power in the lights it established. A bracket carries the different contacts, keeping them in positive position relative to the commutator, while the wires running from it to the bottom of the box make connection with the different sections of the resistance, each of the latter being wound equal to one of the lamps in the circuit.

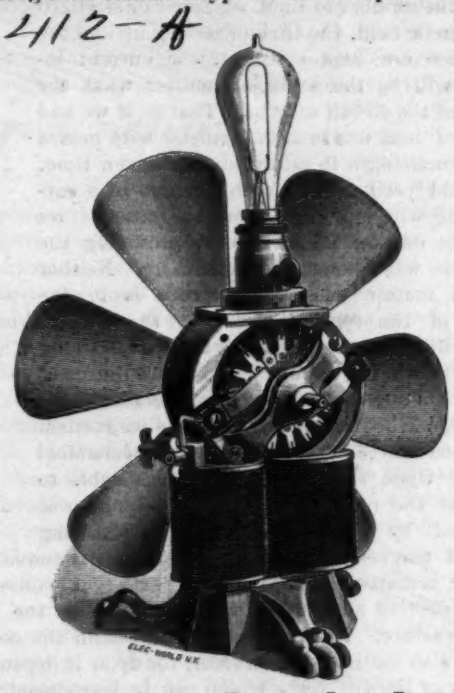
The resistances are of German silver, wound upon a hollow tube of non-conducting material, which, at the same time, is a good conductor of heat. This secures the double advantage of affording radiation of heat over quite a large surface, and the free exposure of the wire to the cooling effect of the air both within and without. In other words, each tube is a chimney causing a constant draught of air through it. The motion of the core, therefore, increases or decreases the amount of resistance thrown into the incandescent circuit until the balance is again established. Of the four binding posts shown, the upper ones connect with the main arc circuit, and the lower with the incandescent lamps.



BAKER'S AUTOMATIC GOVERNOR.

A Novel Combination of Electric Motor, Fan and Lamp Resistance.

The extreme heat through which we are passing makes the presence of a fan driven by an electric motor a source of great comfort. To adapt their motors to this service the C. & C. Electric Motor Company, of this city, have designed a special arrangement, which is shown in the accompanying illustration. Heretofore, as a rule, in fans driven by electric motors, the fan had been connected to the motor by a belt, on account of the high speed at which it is desirable to have the motor run, and the low speed necessary for the fan. The result is that the belt is apt to slip off or break, and a considerable percentage of the power is lost in the friction of the additional countershaft required, to which must be added the trouble of oiling the countershaft. To overcome these objections the C. & C. Company make a simplified and concentrated apparatus by turning their standard type of motor upside down, so as to raise the shaft high enough to bear the fan. The construction of the fan also is such that it will run efficiently at the high speed at which it is desirable to have the motor go.



COMBINATION OF MOTOR, FAN AND LAMP RESISTANCE.

It will be observed that the blades are curved, so that besides giving strength they strike the air nearly edgeways so as not to disturb it, like a sharp-prowed vessel cutting the water; and as the air slides along the blade the obliquity of the blade gradually increases, giving the air a gradually increasing impulse—which is the best method of putting a body in motion. The C. & C. sewing-machine motors are placed the other side up in order to bring the shaft as near as possible to the table, so as not to jar the sewing-machine when running fast.

By turning the motor upside down a cheap cast-iron base can be used, heavy enough to give the whole apparatus stability, without losing much magnetism through its far-reaching legs. The casting, it will be noticed, is attached at the neutral or yoke portion instead of at the pole piece end, where, if a base were used, it would have to be made of brass.

As it is frequently desirable to reduce the speed of the fan a resistance has been added to the motor in the shape of an Edison lamp, which is mounted on the top of the pole pieces. By turning the lamp-switch the lamp can be put in series with the motor and the resistance thus introduced reduces the speed of motor and fan.

The Bradley Dynamo Machine.

BY C. S. BRADLEY

In the beginning of experiments on the construction of dynamos it was realized that to get maximum results a high surface speed of armature must be attained; but at the same time, it was shown to be most desirable to have as few revolutions per minute as possible. Hence, it was clear that the only way to accomplish this mechanically was by increasing the diameter of the armature, and, that the weight of material might be small, it was necessary to have the armature short in length. This led the writer to a thorough consideration of the theories of induction in the dynamo machine. He found the one most accepted at present., viz., that involving the number of magnetic lines of force cut per unit of time, to be quite unsatisfactory, because it only takes into account the piece of conductor which passes through the gap in the magnetic circuit, and leads one to think that only those lines of force in the immediate vicinity of the conductor have an effect upon it.

Let us take, for instance, a machine of the drum form of armature. Here we have a portion of the conductor on the face and another portion across the end; the part on the face is said to cut the lines of force as it passes through the magnetic gap, while the part on the end is said to be necessary only to unite those portions on the face and thus complete the electrical circuit, and that, it is alleged, is all the function they perform.

Now, undoubtedly, the induced current is produced in the secondary circuit of an induction coil in the same manner as it is in a dynamo machine, with the exception that in the coil the lines of force are introduced and withdrawn from the circuit by electrical means, and in the dynamo by mechanical means. In the coil one cannot look upon the magnetism as being introduced or withdrawn from any particular side of the circuit, and, for simplicity, let us consider the circuit as composed of one convolution of circular or rectangular form; while in the dynamo for mechanical reasons we must introduce them on one side, and either withdraw them from the same or the opposite side of the convolution.

Now in the case of setting up the magnetic lines of force by electrical means we all know that if the number of lines of force or strength of magnetic field, the time of setting up and the resistance are kept constant, the current induced will be the same, no matter what the length of the circuit may be. That is, if we had a core of iron one inch in diameter with means of magnetizing it to saturation in a given time, we could produce as much current in a surrounding wire one foot from the core as we could in one an inch from it, providing the resistance was the same in both cases. Neither does it matter whether the core is in the centre of the space inclosed by the wire or at one side near to one part of the wire, so long as it is within the circuit. And as the source of magnetism ought not to change the result, the effect should be the same whether the magnetism is placed there by electrical or mechanical means. Upon this basis it seems reasonable to say that the induced current in a dynamo is produced by introducing and withdrawing lines of magnetic force into and from the convolutions of the armature, and that one part of a convolution is as effective as another, whether it be on the end or on the surface. The amount of area within the convolution is also an important factor, for upon it depends the number of lines of force which can be introduced at any one time, and here we see the importance of the conductor on the end of a drum armature. It also shows why large machines are relatively more effective per unit length of conductor on armature than small ones.

We now arrive at a point where the length of convolution may be considered. In most dynamos, at least those most easily constructed, the convolutions are nearly rectangular and the rectangle whose periphery is the shortest and still contains the greatest area is a square, so that a machine whose windings are square, other things being equal, gives the greatest E. M. F. with the shortest length of conductor. This explains why a Siemens armature should have a core whose length is equal to its diameter. Circles give greatest area per unit circumference, but are not generally permissible for mechanical reasons. These considerations early brought the writer to the conclusion that multipolar machines were the only rational solution of the problem. By this means we would be enabled to introduce and withdraw the lines of force into and from the convolution, or, as it was decided to have them squares, a number of times in each revolution. We could also have much greater diameter of armature relatively to the length, and still have well proportioned magnetic circuits.

This resulted in the construction of a six pole Gramme ring machine, with the commutator cross connected, so that the bars of equal potential and sign should be united, in order that two brushes would suffice. The machine produced excellent results, but it was found that heating

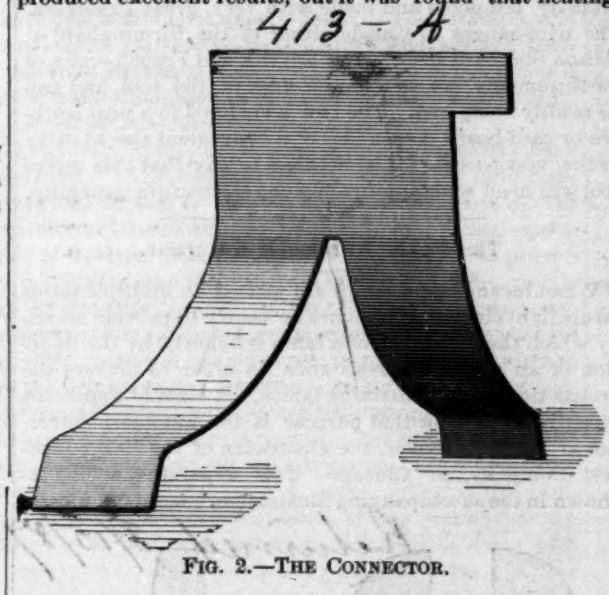


FIG. 2.—THE CONNECTOR.

in the armature occurred which could not then be accounted for; so the cross connections were removed and six brushes put on, so that each section might be tested out separately. Then it was discovered that there was as much as 6 per cent. difference in E. M. F. between the different circuits, which was due to the unequal strength of the magnets. These might be balanced by using great care, but on breaking the circuit of one magnet coil the machine was practically short circuited within itself when the circuits were united, and as this is liable to occur at any time, this arrangement would not make a very desirable machine.

It then occurred to the writer that there ought to be some way of winding an armature for a multipolar machine which should have a continuous winding with only two multiple arc circuits, the same as in a simple gramme or

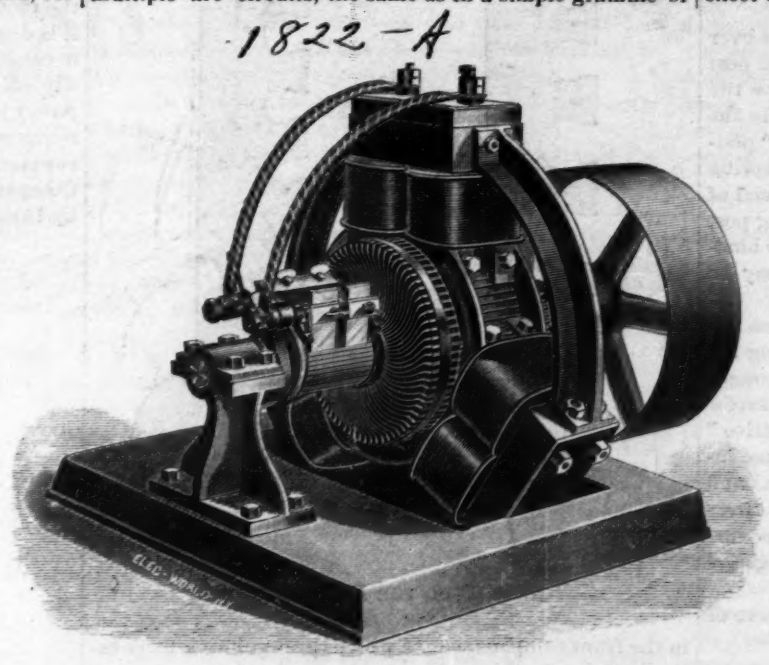


FIG. 1.—THE BRADLEY MULTIPOLAR DYNAMO.

Siemens armature, no matter how many pole pieces were used. Considerable thought and a little experiment brought out what was wanted, only to find soon after that Mr. Hermann Müller, of Zurich, Switzerland, had accomplished the same thing in the following manner: The armature has the conductors wound upon it in one continuous course, so that the distance between each two successive induced portions of the conductors is greater, or less, than that between the poles of the field magnets, according to the formula:

$$D = d - \frac{n}{p}; \text{ or } D = \frac{n}{p} - d.$$

The induced current flows from one brush to the other through the whole system of conductors in such manner that, however simple or complex the system of conductors may be, the average value of the distance d between every two induced parts which follow next to one another, always conforms to the condition,

$$d = \frac{u}{p}\left(1 \pm \frac{1}{n}\right), \qquad (1)$$

where u = average circumference of armature;
n = number of segments of the collector;
p = any equal number of field-magnets not less than four.

The collector is made, as usual, of a number of insulated metallic segments, which are connected with the elements of the continuous conductor of the armature.

Supposing the circumference u to be divided into a number of equal parts, n, and that $\left(\frac{1}{n}\right) u = 1$, then it follows that $u = n$, and equation (1) takes the following form:

$$d = \frac{n \pm 1}{p}; \qquad (2)$$

and from this

$$n = (d \times p) \pm 1. \qquad (3)$$

From these equations it follows that for each circumferential progression or advance d of the conductor elements (of simple or complex form) a successive displacement takes place relatively to the axes of the magnetic fields, and that this displacement may either be a lead or a retrogression, as preferred. The circumferential distance between two succeeding field magnets being equal to $\frac{u}{p}$ or $\frac{n}{p}$, the average value D of the displacement (lead or retrogression) will, therefore, be for each progression or advance

$$D = d - \frac{n}{p}; \qquad (4)$$

and substituting herein the value of d from equation (2) we get

$$D = \pm \frac{1}{p}, \qquad (5)$$

so that after p progressions the total lead or retrogression will be

$$p\,D = \pm 1. \qquad (6)$$

The conductors of an armature constructed or wound according to the laws laid down in the foregoing equations will result in an endless or continuous system of conductors which, when rotated in the magnetic fields of an equal number of magnets not less than four, will produce a continuous electrical current.

This winding is applicable to all sizes, and any number of volts or ampères, and also to either ring, drum or disc forms of armature. For mechanical reasons the drum is to be preferred, being more easy to mount upon the shaft and capable of having end play to distribute the oil in the bearings, and give an even wearing surface for the brushes on the commutator. At first it seemed quite difficult to construct the armature for a high number of volts, but by special designs and methods it is now done with great facility. Where the use of bars is permissible, as for incandescent lighting, a connector stamped from sheet copper and formed up in cast iron dies, as shown in Fig. 2, is used to connect the bars. The latter projects beyond the core a sufficient distance to lap on the connector over its whole width, each alternate bar being longer than its neighbor by the width of one leg of the connector and the insulating space. The connector then connects a long bar to a short one, the two being about one-sixth the circumference apart in the machine shown in the engraving Fig. 1, which is a six-pole dynamo. The variation from one-sixth of the circumference is due to the progression or retrogression. Then the short bar referred to above is connected on the opposite end of the armature to a long bar about one-sixth farther in advance, and so on around the armature. When the vicinity of the first bar is reached, if it is a progression, the connector joins the next succeeding long bar; then around again, the same as before, until about one-half are on; then the short bars adjacent to the starting point are joined in the circuit and when all are on, the last connector joins the long bar which was started with, making one continuous winding uniform in all its parts.

This description is given in order to convey an idea of the electrical operation of the winding. In practice the number of bars are planned so that when the connectors are all put in place at one time, the connections must of themselves come right. The number of bars must be either two less (progression) or two more (retrogression) than a multiple of the number of pole pieces, a factor of which multiple must be an odd number. Thus the machine shown has 148 bars, and 148 is two less than 150; which is six (the number of pole pieces) times 25.

The odd number, 25, is necessary because the connector must run from a long to a short bar, and because the long and short bars must alternate in order to give room for the connectors and insulating spaces. The connectors throughout all their parts have between them about $\frac{1}{4}$ of an inch space for insulation and the passage of air which is facilitated by the curved form.

The core of the armature being about 6 inches long the transmission of heat from the centre of each bar to the connectors can take place when fully loaded with a difference in temperature of only 7 degrees centigrade. It is therefore safe to say that the ventilation is perfect.

In the first large armature made on this plan the bars were on the surface of the core and about one-quarter of an inch square in section. The eddy currents proved so great as to reduce the advantages of the machine to a par

with those of a two-pole machine. As the bars enter and leave the magnetic field so many more times in each revolution, this difficulty is much aggravated in multipolar machines.

But the construction of another armature with the bars let into the iron core had already been commenced on the theory that the rectangular form of winding should have the lines of magnetic force introduced and withdrawn by way of the iron core, and that the conductor should get its induction the same as it does in the induction coil or converter, that is, by its surrounding a mass of iron which is alternately magnetized and demagnetized. It then occurred to the writer that this construction would also entirely dispose of the eddy currents, because the lines of force, being conveyed by the iron, would not penetrate the copper bar and the induction would take effect throughout the bar at one time and thus produce a uniform E. M. F. Experience has fully borne out these conclusions.

In the machine shown in the engraving, Fig. 1, there are 74 slots cut in the armature $1\frac{1}{16}$ inch deep, $\frac{188}{1000}$ inch wide at the circumference, and $\frac{107}{1000}$ inch wide at the bottom. This leaves the iron the same thickness between the slots at the bottom as at the top, the aim being, in these machines, to have the magnetic circuit the same in cross section in all its parts. The sectional area of the yokes, cores of the magnets, and the sum of the cross sections of the bodies of iron between the slots which are under the pole pieces at any one time, are approximately equal. Two bars are placed in each slot, the top one being longer than the bottom one, so as to project beyond it at each end to join the connectors. The top bar is $\frac{420}{1000}$ inch wide and the bottom $\frac{330}{1000}$ inch, so each has the same sectional area. The connectors are clamped firmly to the side of the bar and soldered, and then the clamp is removed the surfaces soldered being much larger than the sectional area of the bars. Mica insulation is used between and at the side of the bars. The slot is $\frac{1}{16}$ inch deeper than the bars, so that it leaves a space below the same to insulate them from the iron. The bars are very easily removed for repairs, and to facilitate this in future machines they will be placed side by side, instead of one on top of the other. There are 74 bars in the commutator, each connector on one end of the armature leading to a bar.

The brushes may be placed 60 degrees apart or 180 degrees. On the present machine, they have been placed 60 degrees apart, but all things considered 180 degrees is preferable.

The iron of the armature runs in such close proximity to the field magnets (the clearance necessary for rotation being the only gap in the magnetic circuit) that the expenditure of energy on the field magnets is very small, being less than $1\frac{6}{16}$ per cent. of the total when machine is fully loaded. This must be conceded to be a remarkably good result when the slow speed of the machine is taken into consideration.

The following table gives the results of a test of the machine illustrated, made by Dr. W. E. Geyer and D. G. Jacobus, M. E., at the Stevens Institute of Technology:

No. of test.	Speed of armature. Rev. per min.	Volts.	Ampères.	Efficiency. Per cent.
1	556.6	50.0	134.40	84.1
2	547.2	51.1	136.94	84.5
3	546.3	51.5	138.59	83.9
4	559.2	45.0	253.82	86.3
5	581.4	51.0	271.34	86.0

The base of the machine is 31 × 31 inches and it stands 26 inches high. The diameter of the armature is $12\frac{1}{4}$ inches and the length of its core 6 inches. The following table gives the weights of iron and copper employed in its construction:

	Lbs.	
Field—Iron, soft Norway	340	
" cast	28	
Brass	23.5	
		391.5
Wire		108.0
Bed, standards, bolts, etc		285.3
Brush holder, brass		10.7
Armature—Iron (sheet)	153	
" cast end plates	14.2	
Steel shaft	36	
		203.2
Brought forward		$203.2
Copper in armature	59	
" commutator	13	
Total copper on armature and commutator	72	
Brass commutator core	5	
Total weight of machine		1,025.7

That we have not yet realized all the possibilities these principles afford us is quite certain, and the writer sees his way clear to a machine, of same weight and output, to turn 300 times per minute, for placing directly on an engine shaft, thus doing away with belting and pulleys. For motors the machine is equally applicable. Thus a motor weighing 1000 lbs., turning 300 times a minute, can be built developing from 15 to 20 h. p., and specially applicable to electrical railroads. It is quite unnecessary for me to draw attention to the low cost of this machine, as the weight of materials used shows this at a glance.

The Daft Electric Motor for the Ninth Avenue Elevated Railway.

The Daft locomotive "Ben Franklin" will shortly make its appearance upon the Ninth Avenue Elevated Railway as represented in the accompanying cut. The experiments in electrical propulsion by the Daft Electric Light Company upon this line have covered quite a period of time, and an epitome of them cannot fail to be of general interest. The first was made in the autumn of 1885 and, although satisfactory within its limit, was not sufficient for the end in view.

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DAFT ELECTRIC LOCOMOTIVE WITH TRAIN OF CARS, NINTH AVENUE ELEVATED RAILWAY, NEW YORK CITY.

The motor was of 75 h. p., and, while fairly equal to the maximum work in shape of load, gradient and speed which could ever come upon it, had not that surplus of power necessary to secure the rapid acceleration at starting which the frequent stoppages make indispensable for a service of this nature. Experiment showed that this effort ranged as high as 120 h. p. with the steam locomotives. The only remedy was to increase the power of the motor to its present capacity—125 h. p.—which was done forthwith.

When just ready for trial, the railway authorities found the conductor then in use—a central "third rail"—an inconvenience to their steam locomotives, and requested the substitution of something else. A copper rod, five-eighths of an inch in diameter, outside of and parallel with the track, was decided upon, and the preparation of over four miles of this, with the necessary insulators, expansion joints, switches, etc., and the subsequent connecting, without interrupting for a moment the routine service, has consumed the entire time, up to the present, which could be spared from the execution of orders for street railways whose completion was subject to stipulated dates. The day of the experiment cannot be definitely given, but it is safe to say it will take place before the close of the coming autumn. Our illustration is a faithful view of the motor as remodelled and attached to the train of cars.

A New Insulating Plate.—An insulating plate which, while very thin and light, is absolutely impermeable to moisture and to air, may be made by taking two leaves of tinfoil coated with a thin layer of gutta percha solution (dissolved in benzine or carbon di-sulphide) and placing them face to face, separated by a leaf of thin paper of close texture.—*London Electrician.*

A Proposed Novel Electric Railway.

In a paper read by Mr. Eugène Hénard before the French Society of Architects, it has been proposed to lay down a "continuous" electric railway or "carrying platform" around the whole of the grounds of the Paris Exhibition. The idea is to lay the rails in a trench of such a depth that an ordinary flat-topped railway wagon just reaches the surface of the ground; the whole circle would then be filled with a train of such wagons coupled close together and provided with a continuous floor. This train is to be driven at a walking pace by a number of electric motors placed at intervals upon or underneath the wagons. Passengers can thus step on or off at any point, and no fares would be charged except for seats. The working of the line would be controlled from signal boxes placed at suitable distances, from each of which the train may be stopped at any moment by opening one of the main leads. The idea, says the London *Electrician*, strikes us as a rather good one, and there should be no difficulty in carrying it out with entire success, and with great convenience to visitors.

Porous Cells Made of Vulcanized Fibre.

According to our contemporary, *L'Electricien*, it has recently been discovered by M. de Rufz that notwithstanding the excellent insulating properties of vulcanized fibre when dry, yet after long soaking in "a liquid" (whether pure water or not does not appear) it swells considerably and becomes very sensibly porous, so much so as to be admirably adapted for use in two fluid primary batteries, or in secondary cells of the Faure type as a separator between the plates. For each of these purposes it is said to be well adapted, because of its very low electrical resistance. We may, however, remark that the apparent resistance of a porous pot is in reality the resistance of the liquid which it contains in its interstices, and therefore varies with the nature of the liquid in which it has been soaked. Hence the measurement of the apparent resistance of a porous pot is an index of the rate at which liquids can diffuse through its walls, so that for primary batteries there will in some cases be a limit below which it is not advantageous to reduce the resistance of the cell. On the other hand, for secondary batteries, and also for primaries used in electric lighting, where the liquids are presumably exhausted before much diffusion can have taken place, the new material seems to give promise of usefuiness. At the Ecole de Physique it was found that the internal resistance of a Bunsen cell, which measured .06 ohm, with an earthenware pot, was reduced to rather less than 0.03 ohm on the substitution of a vulcanized fibre cell $\frac{1}{4}$ mm. in thickness. One advantage cells of this description would undeniably possess is in the reduction of weight, and M. de Rufz attaches considerable importance to this point as facilitating the employment of primary cells for the propulsion of tricycles, balloons and boats. It is, however, necessary to add this caution; vulcanized fibre dissolves rapidly in the solution of certain salts, amongst which are the bichromates of potassium and of sodium, and it is also attacked by concentrated sulphuric acid, although in the dilute acid it remains unaffected.—*London Electrician.*

The Electric Light in Omnibuses.—The London Road-Car Company is trying the experiment of lighting its omnibuses with the electric light. An "Eclipse" battery has been placed underneath the driver's seat of an omnibus running from Liverpool street to Victoria Station, and supplies a current sufficiently strong to keep alight a small glow lamp of the Swan and Edison type. This gives a light far superior to anything usually seen in public conveyances, and it is said to cost only about one penny per working night, but of how many hours is not stated. When the light is used continuously the cells have to be refilled every 16 hours.—*London Electrical Review.*

Electric Lighting in Chicago.—The Western Electric Company has been awarded the contract for lighting the city of Chicago. The Fort Wayne Jenney Electric Light Company filed a protest against the award.

Use of Electric Light in Telemetry.

Up to the present time, the idea of using the electric light as a measurer of distance has not been entertained. Nevertheless, at night this might be of the greatest advantage, and by the process suggested to us by M. Edme Genglaire, not only could a ship provided with producers and reflectors of the electric light discover the enemy stationed at greater or less distances, but at the same time it could in the simplest manner determine its distance.

To do this, it is only necessary to establish in the bow and stern of the ship reflectors, whence can be projected on all points of the horizon luminous rays of equal intensity. If now from each of the two reflectors two luminous rays are caused to converge upon the same point, the distance from which to the ship is to be determined, a triangle will be furnished for solution whose base (the distance separating the two reflectors) and two adjacent angles are known.

To facilitate the measurement of these angles, the support of each reflector carries a needle, perpendicular to it and which moves over a graduated circle. With regard to the distance to be determined, the two luminous rays can be regarded as the sides of an isosceles triangle whose base is the space between the reflectors, and this consideration will yet be of the greatest use to us.

The two luminous rays being equal in length, the angles at the base are equal, and their sum subtracted from 180° gives the angle at the apex; and it may be assumed that, the distance from base to apex increasing with the sum of the angles at the base, a table will be arranged containing, opposite to each value of the sum or these angles just spoken of, the corresponding distance from the base to the desired point. The two luminous rays grow larger as they increase in length, and it is only with difficulty that the point seen will be brought into the central axis of both converging rays. It is only by a succession of trials that this question can be determined, and great precision as yet cannot be looked for. Following out the above course of reasoning, a ray of light should be projected upon the desired point, so that it shall be well lighted by the central luminous area. The angle of the reflector required for this result is to be calculated, it is multiplied by two, and the table constructed as a preliminary will show opposite the doubled angular value the desired distance.

This process will be of the greatest utility on account of its ease of execution, on occasions when great exactness is not required and where quickness is of importance. On the other hand, the table can be determined experimentally.—*Electricité.*

The Hill Friction Clutches.

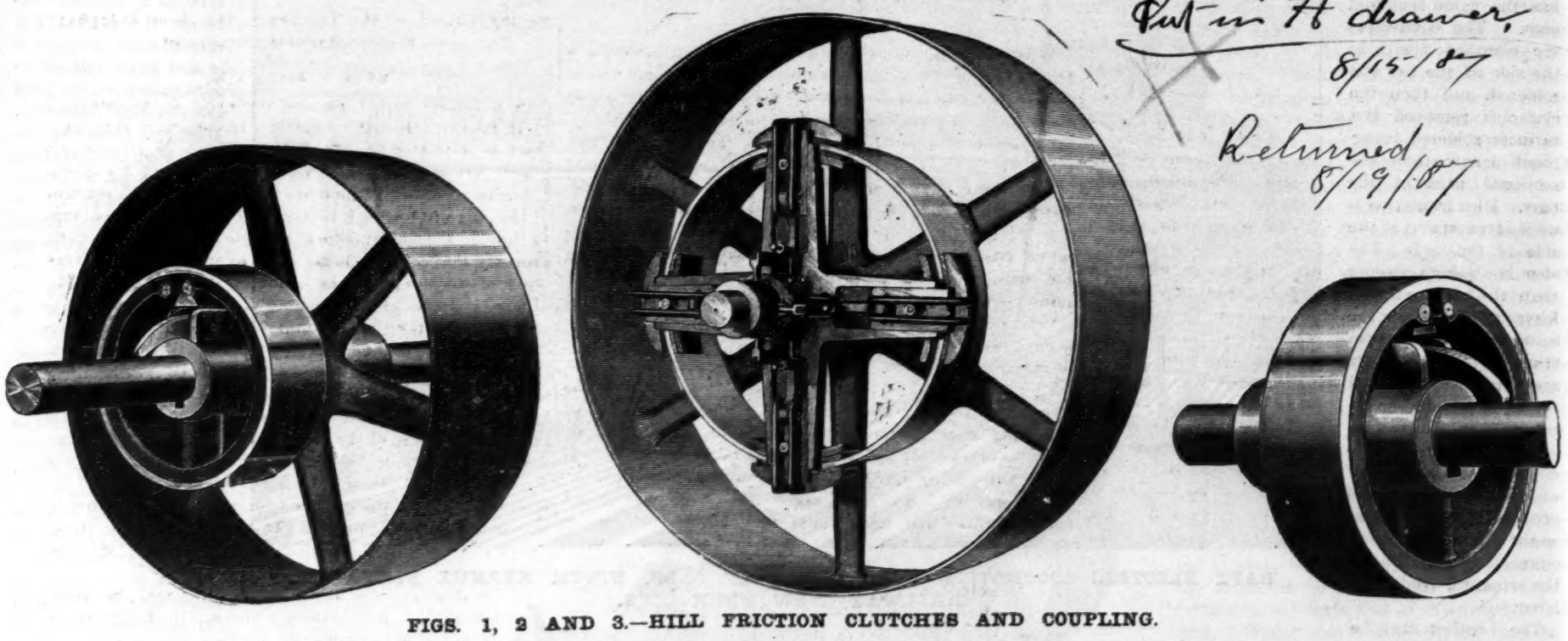
The ease with which single machines and whole lines of shafting can be thrown in and out of action by means of the friction clutch has made the latter a favorite in electric light stations. A friction clutch that has come into extensive use is that known as the Hill friction clutch, the systematic manufacture of which has recently been begun by the Hill Clutch Works, of Cleveland, O.

The Hill clutch, type "A," is made with either two or four arms, according to the amount of power to be transmitted. As shown in our illustration, Fig. 1, it has a clutch ring cast on the arms of the pulley. This ring is turned and finished perfectly true, and is grasped on the outer and inner sides by the eight clutch members, which are shod with thoroughly seasoned maple. The radial motion of the jaws or clutch members is produced by the sliding collar at the left, which is pushed toward the clutch. This operates the link and the two angle levers with which it is connected to the clutch jaws in such a manner as to force the outer jaws inwardly and the inner jaws outwardly, until they grip firmly both sides of the ring. The position of sliding collar is then such that it cannot be forced out. By moving the sliding collar out by means of a long lever attached to it, the jaws or frictional surfaces are instantly disengaged. The clutch is operated very easily and without start or jar to the machinery, and is key-seated securely to the shaft, the pulley running loosely. The same is nicely finished and accurately balanced, and fitted with an automatic grease cup and the Hill removable split sleeve or bushing, which for high speed is lined with Babbitt metal. The slight wear on the wood jaws may be taken up by set screws, and when worn out they may be renewed.

The new Hill clutch, type "B," shown in Fig. 2, supplements in size the "A" clutch, which is only made as small as 18 inches in diameter, while the "B" clutch is made as small as six inches.

The operation of this clutch will be readily understood. The clutch consists of an outer and inner ring, the outer one being sometimes cast on the arms of the pulley, or, as shown in the illustration, fastened to the hub. The pulley with the outer ring runs loosely on the shaft, while the inner ring is key-seated securely thereto. The clutch is operated by means of a sliding collar, which is pushed up against the small lever, which forces up a wedge that expands the inner ring against the outer ring, holding the same securely together. The clutch is fitted with an automatic grease cup, which lubricates the frictional surfaces and prevents wear, but which does not prevent its holding firmly. This "B" style of clutch is built as large as 72 inches in diameter, but the large sizes are built slightly different. The inner ring is divided into two parts, or rather may be said to consist of two arms, and is expanded by two levers, in the same manner as the smaller sizes.

Besides the clutch pulleys the same firm manufacture the clutch coupling shown in Fig. 3, based upon the same principle as the "B" style of clutch pulley. We may add that the Hill Clutch Works also make a specialty of electric lighting work, contracting to put in the entire plant ready for steam, and they report that they are working on half a dozen different plants, and are preparing to double their capacity.



FIGS. 1, 2 AND 3.—HILL FRICTION CLUTCHES AND COUPLING.

On Magnetic Torsion of Wires.*

BY SHELFORD BIDWELL.

This is an account of experiments made on the twisting produced by sending a current along magnetized iron wires, and the author shows that Wiedemann's explanation of these phenomena (by assuming a difference in molecular friction at the polar and lateral surfaces of magnetized molecules) is unsatisfactory. The wires were magnetized longitudinally by means of a solenoid in the axis of which the wires were suspended. To obtain consistent results it was found necessary to demagnetize the wire between the observations. This is done by reversed currents of gradually decreasing strength, and a simple arrangement of rheostat and commutator devised for this purpose was exhibited.

Two sets of experiments were made, in which the current in the wire or solenoid was kept constant while that in the other was varied. The amount of twisting does not increase continuously when the currents are increased but attains a maximum when the inclination of the helix, representing the direction of magnetization, is inclined at about 33 degrees to the axis of the wire. When the current in the solenoid was kept constant and that in the wire increased, permanent deflections remained on stopping the current. For small currents in the wire this deflection was diminished on starting the current, while stronger currents increased the deflection. For some intermediate value of the current no change took place. (This value was dependent on the current in the solenoid.) Experiments were shown illustrating these phenomena.

* Abstract of a paper read before the London *Physical Society.*

The Experimental Tramway Line at Southwick, England.*

On Tuesday last, upon the invitation of the Electric Traction Syndicate, the representatives of the technical journals were present at "a private demonstration of electric traction" on the line between Shoreham and West Brighton. The line itself was built by a local company some years ago, but has never paid its way, and it has been in the hands of the syndicate for experimental purposes during the past twelve months, during which period an elaborate series of tests have been carried out. The total length of the line is about 4¼ miles, and presents features which are of considerable value for the purpose in view. The gradients are numerous and in some cases exceptionally severe, rising to 1 in 20 where the road crosses a bridge at Southwick, and there are two sharp curves of about 28 yards radius, one of which is on an incline of 1 to 100. When to this it is added that the road has not been maintained in very first rate order, it will be seen that the line is particularly well adapted to test the capabilities of any system of traction. Indeed, it may be remarked that Messrs. Aveling and Porter, the engine builders, have been experimenting with a new type of steam engine upon the same line concurrently with the electric trials. The average coefficient of traction has been found to vary between 42 and 55 lbs. per ton, according to the state of the metals; upon a well-laid London line this coefficient does not usually exceed 30 to 35 lbs. per ton.

The engineers of the syndicate are of opinion that while electric traction upon lines where the cars follow one another at short intervals is best applied upon the cars themselves, yet that a wide field exists for the use of electric locomotives upon suburban lines where heavier loads are carried at longer intervals, and the conditions approximate more nearly to those of a railway. The trials upon Tuesday last began, therefore, with a short run upon an electric locomotive car, weighing about 12 tons, and designed to draw a bogie car, with seats for 60 persons, at a mean speed of 8 miles an hour, additional accommodation for 14 persons being provided upon the locomotive itself. The motive power is obtained from a set of 168 A size Tatham cells, discharging at 50 or 60 ampères, with a capacity of 200 ampère hours. The motor, which is of the Immisch type (SM9 on their list), series wound, runs at 650 revolutions. The armature is 9 inches in diameter, and is geared direct to the driving wheels by pinions at each end of the spindle, which mesh with internal teeth upon a circular rack on the wheel. The ratio of the teeth is 10 to 67. The motor is suspended by sleeves on journals cut in the axles, which are of steel, and has a tension bar from the centre of the fields to the end framing, to act as a fulcrum. But although this gearing has given good results in practice, yet it has been considered desirable to seek for a less expensive form of gear of equal efficiency; this having, it is believed, been found, it is not intended, as a rule, to resort to the arrangement just described. For this reason the trip of the locomotive was not of great length, nor were any measurements taken.

Returning to the engine-house at Southwick a self-contained car was next tried, upon which the party made the journey to Shoreham. At this place a halt was made for lunch, and afterwards the car traversed the whole length of the line to West Brighton, attaining a mean speed of

slightly over 11 miles an hour; the maximum speed probably approached 16 or 18 miles an hour on some of the inclines. This car is capable of seating 20 passengers, and by itself weighs one ton; the weight of motor and gearing is one ton, and the accumulators 1.75 tons; a total rolling load, when full of passengers, of about 5.25 tons. The wheel base measures 5 ft., and the wheels are 2 ft. 6 in. in diameter. The cells, which are eighty-four in number, are of the Tatham type, B size, with a normal discharging rate of 45 to 50 ampères, and a capacity of 150 ampère hours. They are divided into two separate batteries, each battery being again divided into two halves. By means of a suitable switch, designed by Messrs. Immisch & Co., the two halves of each battery can be connected either in parallel or in series, and the two batteries can also be connected in parallel or in series with each other. Out of these four possible arrangements it will be seen that two amount to the same thing electrically, so that only three different speeds are obtainable by this means. In actual practice it has been found that these three speeds fulfill all requirements.

The motor is again of the Immisch type (SM7), series wound, and runs 1,000 revolutions, with 160 volts and 40 ampères. The experiments carried out by the Syndicate have largely been directed to the question of heavy motors running at slow speeds geared direct, *versus* lighter motors running at higher speeds with second-motion gear. With slow speed motors the question of weight assumes great importance, not only because the motor itself must necessarily be comparatively heavy, but because at slow speeds the torque is so great that the gearing and all structural parts connected with this or the motor have to be additionally strengthened. These additions to the dead weight, combined with the slower speed, necessitate also a greater current in starting and upon inclines, and thus reacts injuriously upon the batteries. A speed as low as 350 revolutions has been tried, but the experience gained has led to the conclusion that a considerably higher speed is desirable, even although the gearing becomes more complex. The motor now preferred runs at 1,000 revolutions, and drives by means of chain gearing.

The chains are of a type specially designed by Mr. Hans Reynolds, of Manchester, and the links are exceptionally heavy. By means of an intermediare shaft the speed of the driving wheels is reduced in the proportion of 1 to 9, and means are provided for taking up the slack of both chains by shifting the journals. The gearing runs with great smoothness and an almost entire absence of noise; in fact, the car runs without more noise than a horse car.

The motor weighs about 5½ cwts., and has an efficiency of conversion at full load of 85 per cent. Its average working efficiency probably lies between 75 and 80 per cent. By winding the armature with smaller wire this could probably have been increased without reducing the normal output; but the element of safety which exists in an armature capable of taking an excessive current would be reduced in proportion. In this case the factor of safety as regards the sectional area of the wire is so great as to admit of the car being stopped and started upon an incline of 1 in 20. It was proposed on Tuesday to repeat this experiment, but time did not permit. The current, however, probably exceeded 100 ampères under this test.

The readings of the ammeter taken during the run showed that under an E. M. F. of 80 volts the current averaged 35 ampreès on the level at a speed of 8 to 10 miles an hour, rising to 45 ampères on an incline of 1 in 120. When the cells were placed in series, giving a terminal E. M. F. of 170 volts, the mean speed increased to 12 or 14 miles on the level with a current of 45 ampères. On the incline of 1 in 20, and going round the sharp curves, the current increased to 80 ampères. These figures are little more than approximate, but were taken as a rough verification of the results obtained by more careful tests made at leisure by the engineers of the syndicate.

American Figures at the English Telegraph Jubilee Dinner.

Among the special dispatches of congratulation received and read at the English Telegraph Jubilee dinner was the following from Gen. Eckert, addressed to Mr. Preece:

"Pray accept for yourself and the other members of the telegraphic fraternity who are present the warm congratulations of Dr. Green and myself on the occasion of your jubilee dinner. We who are so busily engaged in the development of the telegraph are perhaps the least conscious of the multitude of blessings which have followed and which still follow in its train. We cannot divest ourselves of the arduous toil and the exacting details which have marked its progress step by step, and which spoil for us the complete perspective of the great results which have been achieved. It, however, seems almost incredible that my practical experience should cover a period which began with short circuits that succumbed to almost every summer shower, and has now reached a point when we frequently send, almost irrespective of weather, about 50,000 words in the evening over direct circuits nearly 4,000 miles long for publication in the San Francisco papers the next morning. In fifty years the telegraph in America has grown to the gigantic proportions of the Western Union Company: that is, 475,000 miles of wire, or enough to girdle the earth nineteen times. This development has enlisted the endless endeavor of some of the brightest intellects of the age, and represents everywhere an equal indebtedness to the untiring loyalty and zeal of the rank and file of the telegraphic profession. The telegraph has been one of our greatest pioneers wherever man has gone. Into the wilds in search of treasure, or to cultivate the soil, he has taken it with him. At first it has supplied his necessities nearly as soon as they have arisen, and then it has brought him luxuries almost as soon as he has desired them. While the railroads have been the means of quicker transportation, the telegraph has been, if I may so call it, the nervous intelligence which has informed their movements, enlarged their facilities, and enriched their results. In a few months by these means towns have sprung up in the virgin forests or on the desolate plains, and in a few years they have by the same means developed into opulent cities, giving prosperity and contentment to thousands. Add to this the achievement of submarine telegraphy, and are we not identified with, and, in fact, part and parcel of, one of the greatest powers for good, not only of this marvelous nineteenth century but of all time? The kinship of nations has been strengthened by the telegraph, and most of all between England and America the incessant streams of messages across the Atlantic bear silent witness to the bonds of affection, sympathy, and interest which bind the two peoples together. The next generation of telegraphers will start with results which were undreamed of to us in the infancy of the art. Let us hope that they will not disdain to remember with some degree of interest and sympathy the debt which their perfection owes to the perplexities, bordering sometimes on despair, which accompanied the early efforts of the senior ranks to which you and I belong.

Saline Crystals Obtained by Electrolysis.

BY ALEXANDER WATT.

While electrolysing a solution of nitrate of alumina, a few days since, some remarkable effects presented themselves upon the negative electrode which may be worth recording. In the first instance, a piece of stout copper wire was used for a cathode, and after a few moments' immersion, this became covered with bubbles of hydrogen of unusually large size, being about the size of No. 8 shot, while some were considerably larger. The gas had little disposition to leave the plate, even when briskly moved about in the bath. On removing the wire from the solution after about two minutes' immersion, it was found to be coated with a transparent crystalline film, some of the crystals standing out from the copper surface, in the form of plates, to the height of about ¼ inch. The wire was now dipped into a test tube containing hot water, to ascertain whether the crystals were soluble or otherwise, when it was noticed that they were *insoluble*. Some of the crystals eventually dropped off and quickly deposited at the bottom of the tube, while the remainder retained their position. The copper wire was next taken out of the water, and the remaining salt upon its surface allowed to dry, in doing which it assumed an opaque white powdery character. Treated with dilute nitric acid, the powder became dissolved, and the solution, being afterwards treated with a solution of carbonate of soda, yielded a flocculent white precipitate. While the crystals referred to were forming upon the cathode, aluminium oxide was produced at the anode, from the surface of which electrode bubbles of oxygen were also given off. The conclusion I arrived at was that the crystalline substance deposited upon the cathode was *nitrate of aluminium*, but I shall be pleased to be set right if I am wrong in my hasty conjecture. The experiment was shortly after followed up by employing a strip of sheet copper for the cathode, and giving a longer immersion, when the crystalline deposit became more extensive and the flat plates of the salt much larger.—*London Electrical Review.*

The Conductivity of Wires.

In an interesting paper presented by M. Mialaret to the *Société Internationale des Electriciens*, the author points out that our measurement of the specific resistance of wires of different metals is open to some ambiguity, unless it is stated whether we refer as a standard to a wire of given length and sectional area, or of given length and weight. In this country samples of copper and bronze are frequently referred in the trade both to the foot-mil. and foot-grain as determined 30 years ago for "pure" copper by Mattheissen, the result being that, when the comparison, as is most usual, is made by weight, improved processes now frequently enable manufacturers to turn out wire of 101 or 102 per cent. conductivity. But the improvement in wires of so-called "high conductivity" results, as a matter of fact, as much or even more from the greater density which can now be given to the metal as from its greater purity. It follows that comparisons with the two standards of weight and volume no longer agree among themselves, since the density of the metal differs so considerably from that of pure copper. In fact, the actual conductivity of the wire referred to unit volume in many cases *considerably exceeds* the quotation taken with reference to the standard of weight, and although it is much more convenient to weigh a quantity of wire than to ascertain its length by actual measurement, yet it is evident that unit volume rather than unit weight is the proper standard of reference. Not only is it the recognized theoretical standard, but it is usually of more immediate practical importance. The divergent results given by the two standards of reference are well illustrated by the following table of measurements, by M. Mialaret, furnished by three different samples of wire of high conductivity:

	1.	2.	3.
Specific gravity	8.897	9.32	9.6
Conductivity for equal volumes	102.4	106.7	110.8
" " " weights	101.7	101.2	101.6

These percentage conductivities are taken in reference to Matthiessen's standards. It would appear from this that manufacturers may be unwittingly doing themselves an injustice in the statement of percentage conductivities. The remedy is simple enough; the employment of percentage quotations is utterly unnecessary, and is a mere survival from the period before any uniform standard of resistance had been accepted. All we want to know is the actual resistance in ohms of a given volume or a given weight of wire of given section area, and at a definite temperature. If, however, the standard of weight be preferred, then it is necessary for purposes of comparison to know also the specific gravity of the metal. We should thus at once get rid of the unscientific and somewhat absurd method of quoting 101 per cent. conductivities, while the uniform quotation of actual resistance will often save calculation. It is true that in this country many of the leading firms already follow this method, but it is still by no means universal abroad, and in any case M. Mialaret will have done good service in calling attention to the discrepancy between the two different customary standards of reference.—*London Electrician.*

On the Theory of the Telephone, the Mono-Telephone or Electro-Magnetic Resonator.

BY M. E. MERCADIER.

In a former paper* on the theory of the telephone, I think I showed that the magnetic diaphragm of this apparatus is animated by two different kinds of movements which are superposed. One kind consists of the movements of resonance, which are molecular and independent of the outward form; it is these that enable the diaphragm to transmit and reproduce all sounds, a characteristic property that ought to have been expressed in the very name of the telephone by calling it pan-telephone. The others are harmonic movements and are transversal, corresponding to the fundamental sound and the harmonics of the diaphragm, and depending on its elasticity, form and structure; the former are prejudicial to the clear transmission of music and speech, and they alter the *timbre*, the harmonics only coinciding by the merest chance with those of the voice or instruments now in use.

In order to place beyond a doubt the existence and superposition of these two kinds of movements, I endeavored to make the one predominate over the other at will in the same diaphragm. This was effected by means of the following method, which I invented in 1881, and have merely simplified since.

I. The diaphragm of any telephone is placed in conditions favorable to its vibrating transversely freely, and in such a manner as to enable the division into nodal lines corresponding to a determined given sound to be produced. For this purpose, instead of the diaphragm being fixed at its edges, as is generally the case, it is simply placed as near as possible to the pole of the electro-magnet on a sufficient number of points of a nodal line.

If it is a rectangular diaphragm, it is placed upon two rectilinear supports coinciding with the two nodal lines of the fundamental sound. If it is a circular diaphragm, three apertures are made, from two to three millimetres in diameter at the angles of an equilateral triangle inscribed in the circumference which constitutes the nodal line of the first harmonic, and the disc is laid on three points of cork placed in a corresponding manner on a fixed straw and penetrating into the apertures.

This being done, let us introduce into the bobbin of the apparatus a series of currents of very low intensity, and gradually decreasing period, for example, proceeding from the emission of musical sounds before any transmitter whatever, either telephonic or radiophonic. Then the telephonic receiver, modified as already described, only vibrates appreciably under the action of the currents whose period is equal to that of the corresponding sound at the nodal line on which the diaphragm rests, a sound which I will term particular or special; it is no longer pan-telephonic, it is mono-telephonic, and may therefore be called a mono-telephone.

This result is not absolute. In reality the diaphragm sounds some sub-harmonics of the special sound corresponding to the fixed nodal line, but their intensity is comparatively very low, and, besides, the diaphragm reproduces somewhat lower or higher in period than the special sound, but the extreme interval between these sounds is

* *Comptes Rendus*, Vol. CI., pp. 744 and 1,001, and the *Journal de Physique*, 2d Series, Vol. V., p. 141.

very small, and does not generally exceed one or two commas.

These reservations are similar to those that have to be made in connection with resonators in acoustics. Likewise the kind of analysis that a mono-telephone makes of what we may term the electro-magnetic waves is analogous to that made of the sound waves by a resonator. In fact, if we communicate to them a series of successive or simultaneous waves of different periods, each of them selects in a certain degree that of the particular sound that corresponds to its geometrical form, and to the conditions in which it is placed, and greatly strengthens it. The mono-telephone might thus be termed an electro-magnetic resonator.

II. In the arrangement we have just described the transverse movements predominate, and it is easy to see the effect that they would have in an ordinary telephone; for if we try to reproduce by means of a mono-telephone articulate speech spoken into a transmitter, either we hear scarcely anything if the particular sound of the apparatus is not within the scale of the human voice (from the 2d to the 4th C), or else, in the contrary case, we only hear sounds modified in quality and muffled articulations, the whole being drowned, as it were, in the sonorousness of the special sound every time it occurs.

But it is very easy to produce the opposite effect, viz.: to make the molecular movements of resonance predominate over the transverse ones, and thus render the mono-telephone pan-telephonic, and make it reproduce all sounds with the same intensity and articulate speech with clearness.

To do this, it is sufficient to place obstacles in the way of the transverse harmonic vibrations by lightly fixing the edges of several points of the diaphragm; for example, by placing the fingers on it in a certain manner.

The most simple way of performing the experiment is as follows:

We receive into the mono-telephone various successive or simultaneous sounds, among which is the special sound or articulate speech at about the pitch of this sound. We place our ear to the diaphragm; while it is a certain distance away, or at the most just brushing it, we hear only the special sound; but as we apply the ear to the diaphragm more closely, the special sound becomes weaker and weaker, and at last we hear all sounds with equal intensity and articulate speech without any appreciable alteration of quality. By this very simple method we cause the movements of resonance to predominate over the transverse ones, and give to the apparatus the pan-telephonic property possessed by the ordinary telephone with fixed diaphragm.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Aug. 8, 1887.

From all I hear, it is evident that the attendance of New Yorkers at the National Electric Light Convention in Boston tomorrow will be large and well representative of the various branches and industries.

Chas. A. Schieren & Co., of 47 Ferry street, inform me that they have just sold "electric" belting to the Rock Island County Brush Electric Light Company, Rock Island, Ill., and the Glen Falls Gas Light Company, Glen Falls, N. Y.

The house of A. G. Day, 16 Dey street, are now putting on the market a new style of electric light wire, forming an excellent adjunct to the well known "kerite" specialties. It is the "Hotchkiss" wire, the invention of Mr. Clark B. Hotchkiss, who has made a very close study of the desirable features in electric light insulation, and has supplemented a long experience by original investigation. This wire is covered with two separate layers of kerite tape wound spirally in opposite directions, well lapped and semi-vulcanized, which forms an excellent insulation that improves upon exposure to the weather. The tape is covered with an outside braid. By this method of applying kerite compound the ordinary dangers from abrasion are avoided. It is clear that such a wire is not subject to the ordinary leakage, and it is reported of some of it put up in exposed places that, owing to the vulcanization of the tape, it is better after a year's use than it was at first. It is manufactured in two sizes, Nos. 4 and 6 B. & S.

Wall street is now enlivening the dull season by talk about higher cable rates. The general impression seems to be that rates will be brought up to the Commercial Cable level before long; *i. e.*, that the Commercial rate of 40 cents will be accepted by all the competing interests. There is talk of negotiations that go even beyond this point—but we shall see.

Mr. P. L. Sandheim, treasurer of the Standard Paint Company, 59 Maiden Lane, reports an exceedingly brisk demand from electricians for the P. & B. paint, as a reliable and waterproof insulator. The paint has been applied to all the subways and conduits in this city.

The Excelsior Power Company, using the Daft motor system in this city, report a remarkable call for motors. As already intimated, their service is likely soon to undergo a very large increase.

The Vitrite and Luminoid Company are enjoying a large lamp trade. I find their lamps in use in a good many places, and hear them well spoken of. Mr. Theodore Mace, the treasurer of the company, tells me that their other specialties are also in favor. The vitrite material employed is being applied to a number of new purposes, and the display of these articles at 182 Fulton street should be seen. It is very interesting.

I was suprised the other day to see how accurately a chart record could be secured by the Edson recording steam gauge. The charts shown me were from the gauge in use on the American Electric Manufacturing Company's steam plant on Liberty Island (statue of Liberty), New York Harbor. None of the charts varied in their pressure over one pound. The chart shows how the steam is kept low during the day, how an hour before starting the pressure is run up to the necessary point and kept there from sunset to daylight without varying outside of one pound. I met Mr. Littlefield, the chief engineer, who keeps these records for the Light-House Board, for reference, and he and his assistants feel highly pleased over their records.

Mr. H. N. Curtis and Mr. C. R. Dean are now associated in representing the Thomson-Houston Company's interests in this section, having their offices at 32 Nassau street, and it is certainly due to their efforts that the Thomson-Houston system is gaining ground hereabouts, so that this region is now literally studded with its plants.

Mr. W. Irwin Wark, who has been out West in the interests of the Empire City Electric Company, 15 Dey street, is now taking a rest that he has fairly earned. He turned in some large orders. Mr. J. H. Blasdell, the manager of the company, is quite *chez lui* in his new quarters, where a fine showing is made. For a new concern, the Empire City Company has done remarkably well.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Aug. 8, 1887.

The Boston Electric Club will have a meeting to-night for the first time in its new rooms at No. 66 Boylston street.

The Boston Rubber Shoe Manufacturing Company have established a branch office at 103 Bedford street for the convenience of their electrical patrons and the jobbing trade of Boston. Mr. G. L. Richards will have charge of the new quarters.

Fort Hill Park, in the suburbs of Lowell, Mass., and the principal public resort of that city, is to be lighted by seven electric arc lamps, commencing next week. The great elevation of the park will give it a brilliant appearance under electric lights.

The installation of the Sprague electric railway at Richmond, Va., is, I hear from the Jarvis people, progressing rapidly, and the station will soon be in readiness for the electrical equipment. The boilers are set with the Jarvis furnace and ready for the piping, and the Armington & Sims engines are on the foundations. The work is being done under the supervision of the chief engineer of the Sprague Electric Company, Mr. J. H. Vail, who also planned the complete station, which, when finished, will be the finest power station in the country. The Richmond people are much interested in the enterprise, and are enthusiastic as to its successful working, though some of the colored population are yet to be convinced that the cars can be propelled without the aid of their mules.

Messrs. Reed & Page, of Worcester, Mass., are combining with their regular line of business (electrical supplies) the installation of electric light plants, both for arc and incandescent lighting, and special attention will be given by them to wiring and constructive work. Now that the Worcester Electric Light Company is about to furnish incandescent lights (Thomson-Houston system), Messrs. Reed & Page will probably be kept very busy wiring stores, etc.

The National Pipe Bending Co., of New Haven, Conn., report sales of National feed water heaters for July as very good. Among those shipped were one 500 h. p. to New Orleans, La.; one 500 h. p. to Houston, Tex.; one 400 h. p. to Atlanta, Ga.; one 400 h. p. to Montgomery, Ala.; one 500 h. p. to Boston, Mass.; one 200 h. p. to Memphis, Tenn.; one 150 h. p. to Starr Mills, Middleboro, Mass.; one 80 h. p. to Chattanooga, Tenn.; three 100 h. p. and one 60 h. p. to Hon. F. L. Ames, North Easton, Mass.; two 80 h. p. to Boston; one 80 h. p. to Electric Light Co., Houlton, Me.; two 100 h. p. to New York; three 50 h. p. to Minneapolis, Minn.; one 50 h. p. to Kansas City, Mo.; one 80 h. p., to Waterbury, Conn.; one 100 h. p. to Chicago, Ill.

It is said that Mr. John G. Low, of the Chelsea (Mass.) Art Tile Works, is probably the first individual in this section to utilize the storage battery for lighting a carriage. He has a Julien battery and two incandescent lamps of five candle-power each, which produce very satisfactory results, and the cost is very small. It is predicted that this use of storage batteries will soon become general, being particularly convenient for cabs and other city vehicles.

A dispatch to the Boston *Daily Globe* from St. Johnsbury, Vt., under date of August 4, states: Steps are being taken to introduce the electric light here this fall. It will cost about 35 cents a night to furnish light of sufficient power for an ordinary store, running from 4:30 to 12 o'clock at night, or in that proportion for a smaller number of hours, averaging, it is calculated, about 6 cents per hour. Water-power can be had at the foot of the avenue, and ample room for the required machinery can be had in the new building to be erected by the Carrick Brothers Granite Company.

W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Aug. 8, 1887.

A dispatch received in this city from China brings intelligence of a terrible plague of sudden death which is raging at Nanking. It says: "People are dying in every quarter, and there are many instances of very sudden deaths. People are apparently well in the morning and dead in the afternoon. The *Hu Pao* says that over 1,000 telegraph poles belonging to the Munanan Mingtaz District and Kweichow Lane line have been pulled down by the people, who say that the telegraph is a diabolical European artifice."

The work of laying underground conduits for all kinds of electrical purposes continues more briskly than ever, owing to the fact that there is a limit to the time in which the streets may be torn up. As a consequence, there is hardly a street in the city which is not rendered almost impassable, in some cases work being done on both sides at the same time. The most extensive work is being done by the Penn Electric Company and the American Telephone and Telegraph Company, the former having an exclusive franchise over a number of the principal streets. The matter has become so obnoxious to merchants and others, who suffer considerable damage thereby, that the Director of Public Works has forbidden the opening of any street on both sides at the same time. Chief Walker, of the Electrical Department, says that he cannot see how any more conduits can possibly be laid, as Chestnut street, for instance, is entirely full, and no more permits can be granted. South, Market and Front streets are in about the same condition.

The operations of the storage car in this city are attracting no small amount of attention. All the papers are willing to devote a large part of their space to the matter, and the public is highly interested. The following is not simply a "news article," but an "editorial," from the conservative columns of Mr. Childs' *Ledger*:

"Another step in the important matter of machine propulsion of street cars in cities—and a very significant step, as we regard it—was made in Philadelphia yesterday. Without proclamation beforehand, and, indeed, without any public notice of what was to be done, an electric motor car was run from the shops of the Wharton Switch Company, at Twenty-third and Washington avenue, along Twenty-third, Christian, Twenty-second, Spruce and Third street to the Merchants' Exchange, at Third and Walnut, and back over the tracks of the Spruce and Pine street line to Gray's Ferry and thence to the starting point. The trip was a complete success, the car with its passengers going along in as matter of course a way as if it had been in operation for years. The single exertion required was to slow down the speed so as to keep the car at a proper distance from the two regular horse cars of the line—the one a block or two in advance of the electric motor and the other a few blocks behind. The car was an old horse car of the People's Line improvised for the purpose. The electric batteries or "cells," eighty-four in number, which furnished the power, were stowed out of sight under the ordinary seats of the car—42 cells on each side—each cell weighing 41 pounds. The motor actuated by the electric current from the "cells," which, in turn propelled the car, was of the "Sprague" type, the whole apparatus being a combination of the Electric Accumulator Company of New York. The general arrangement is that of Mr. Anthony Reckenzaun, C. E., and the practical man immediately in charge, who controlled the circuit wheel and brake (the "grip," so to speak,) was Mr. G. Herbert Condict, of San Francisco, expert in electric light and electric power. Of the trip but little can be said in addition to what has been already observed, namely, that everything moved in the matter-of-course way of an established system. The car and machine were under easy and most absolute control all the time. There was no visible concern on the faces of any one connected with the moving of the car, including that of William Wharton, the active spirit in the enterprise. Before taking the car on to the street it was run around the test track in the shop yard of the Wharton Switch Company, rounding a curve of 33 feet radius and up an incline or grade of five feet in the hundred, or about two hundred and fifty feet to the mile, without noticeable change of speed in the car any more than if on a straight and level track. On the trip to the Exchange and back, there was, of course, no opportunity, as, indeed, there was no necessity, for testing the speed of the car, for it had to be kept even with the speed of the horse cars running on the Spruce street track. It was plain enough, however, that the speed could be put up to a high rate if that should be necessary or allowable.

"Yesterday's quiet achievement seemed to settle the fact that this electric motor, actuated by power which it carries along with it, will do its work with ease, with freedom from any sort of nuisance to the public and with the manageability of horses. The one point to be solved is: How much will this mode of propelling street cars cost? Its projectors feel themselves prepared to say that it will not cost more than two-thirds to three-fourths the cost of horses. About that, however, they are yet to furnish the 'Q E. D.'"

The gang of workmen employed by the Keystone Electric Light and Power Company (Westinghouse system) are the object of considerable attention from those who are on the streets at night when their work is done. They are laying a 16-compartment conduit of creosoted wood in various parts of the city, through which current will be supplied from their central station on Sansom streeth, near Seventh, and, unlike all the other companies who are doing underground work, they travel through only the side streets and alleys, as they believe that the work can be better done by entering a building from the rear. They attract much attention from the fact that two of the gang carry with them incandescent lights of 150 c. p., thus affording a splendid light for the men in the trenches and man-holes. The lamps are supplied through long cords attached to the main circuit at any of the manholes, and are made to furnish light for nearly a block; after which they are cut out and another tap is made. The construction work of this flourishing company is under the supervision of John S. Muckle, who is certainly one of the most popular men in the electric light business in Philadelphia. He is a brother of M. R. Muckle, Jr., who looks after the interests of Westinghouse, Church, Kerr & Co. in this neighborhood.

E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Aug. 6, 1887.

The interest this week has centred in the award of the contract for lighting the river. The advantages of a plant of this kind for advertising purposes are obvious, and that view naturally entered largely into consideration. The plant promises to be unique in many respects. It involves probably the most severe test ever made with submarine cable; while the question was to be solved whether arc lights would light the river sufficiently to permit of traffic. The cost of installing a plant of this kind is very heavy, and unusual contingencies must be provided for. A proposition made by the Chicago Arc Light and Power Co. to rent 100 lights at the rate of forty-five cents each per night seemed to meet with favor at first, and it may yet be adopted. Prof. Barrett, the city electrician, is known to favor a plant entirely under the control of the city.

The bids range from twenty-nine to thirty-nine thousand dollars, as shown herewith. The award will be made in a few days and will be announced in my next letter.

A very unfortunate affair was brought to light this week by the discovery of an extensive system of theft and forgery by an employé of the Central Union Telephone Company. The young man was addicted to gambling and fast life. The amount realized by his forgeries is said to be upwards of $20,000 and was obtained by filling out blank checks and forging the signatures of

the treasurer and president, the checks being destroyed when returned by the bank with their monthly accounts.

The storage battery is now a recognized factor in the installation of electric lighting plants. The fact that a large saving can be effected by their use has already received practical demonstration. Few of your readers realized the extent of the demand for these batteries until your recent article appeared descriptive of the Electrical Accumulator Company's workshops and warerooms.

Mr. Johnson, of Johnson, Holland & Co., has closed a contract for lighting a car for the C., B. & Q. R. R. Co. This car is to run upon suburban trains, and the lamps will be placed on the sides of the car instead of on the ceiling, as upon the vestibule train.

This order is, of course, for experimental purposes, and will undoubtedly be followed by instructions to equip several trains. From experiments already made by the Pullman Company an incandescent 60-volt lamp will give four times the light of the best oil lamp in use. Thirty cells of the Electrical Accumulator Company's battery were used in making the test. Mr. Johnson has also made arrangements to put in from four to eight hundred cells of battery in the Rookery Building of this city. Mr. E. M. Hawley is now connected with the firm of Johnson, Holland & Co.

The scare caused in some circles by the first accounts of the Welsbach gas-lighting system has subsided. The light is on exhibition here in the Home Insurance Building, where somewhat elaborate preparations have been made for the purpose. In one room several Welsbach burners have been placed and in an adjoining room several incandescent lamps. The fact that the incandescent lamps are not up to their full candle-power accounts for the very yellow light. Possibly they are being run that way with an object. Nevertheless the Welsbach is an exceedingly white light, and may find favor for residence use. It looks a very fragile thing. The gentleman in charge states that a company will be formed of representative men with $4,500,000 capital stock to control Illinois, Iowa, Wisconsin, Indiana and Michigan. This company will then sublet territory. The franchise is to be paid for when the sub-companies pay the Chicago company.

I understand that the United States Company have secured the contracts for the Rookery Building (2,000 lamps) and the Haymarket Theatre (1,500 lamps).

The promoters of the Hyde Park Electric Light Company, recently incorporated, are obtaining signatures on a petition to be presented to the Board of Trustees asking for a franchise in Hyde Park. The company proposes to put in a plant near Forty-sixth street and Cottage Grove avenue and run wires over and under ground in all directions. The plant will cost, it is estimated, from $80,000 to $100,000, and will consist of four engines, each of 125 horse-power, and four dynamos—two for the arc and two for the incandescent lights. The lamps, both arc and incandescent, will be put in at the company's expense and maintained by them, while the price of lighting will be 20 per cent. below the cost of lighting by gas. The Board of Trustees will meet Sept. 5 and then the matter will probably come up for consideration.

Dr. A. V. Shaw, of this city, is said to have one of the most complete collections in this country of electrical instruments for mathematical and testing purposes. He is the representative of the Julien storage battery here.

The Western Electric Company has contracted to furnish the electric light plants for the expositions at St. Louis and Chicago during the coming season, also a 60-light plant for the gas company at Stevens Point, Wis.; a 20-light plant for the Kankakee Insane Asylum, and a 25-light plant for Grand Pacific Hotel.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following quotations upon telephone stock:

Bell of Mo.	$155@$157
Central Union	45@ 46
Chicago	385@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Iowa Union	25@ 27
Michigan	76@ 77
Mobile & Kansas	66@ 68
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

C. H. M.

TOPEKA, Kan., August 3, 1887.

The Missouri & Kansas Telephone Company are making extensive improvements in this city. The city has outgrown the present facilities, and the whole plant of the Topeka telephone exchange is being rebuilt, and new and improved appliances are being introduced. As quickly as they can be made, the management will add the Western Electric Company's multiple switchboards. A cable system is also among the improvements. The work has been in progress since April 1, in which time they have put in new poles and new wires, removed and enlarged the office, modernized all the facilities, added new connecting lines to Kansas City, and built a line to Wamego, Kan., and intervening towns.

The Atchison, Topeka & Santa Fe Railroad Company now has four forces at work building a new telegraph line to Kansas City. Thirty-foot cedar poles are being used and one No. 8 and one No. 6 wire being strung. When complete, this will doubtless be one of the best lines in the West.

PACIFIC SLOPE NOTES.

SAN FRANCISCO, Cal., July 30, 1887.

If matters continue as they now promise, California will be the banner State for electric railways. What with roads running or building and those now under negotiation, we are going to see some very active work here. Los Angeles has a road; work is being done in this city; San Jose and San Diego have contracts made; and such places as Ontario, Eureka, Sacramento and others are busy getting ready for the use of the new method of urban life and locomotion.

I notice you have given pretty full accounts of the fire and police systems in such cities as Philadelphia, Chicago, New York, Brooklyn, etc. Here is the report from the Golden Gate, being the annual report of Superintendent Curran, of the Fire-Alarm and Police Telegraph System, filed with the Board of Supervisors. There were during the year: Fires, 299; second alarms, 6; third alarm, 1; total, 306—being the highest number of alarms ever sounded in a year by the office. There are still 13 signal circuits, and there are now 188 signal boxes, of which 171, including three purchased and ready to be substituted in place of crank boxes, are automatic boxes. Ninety-two gongs and tower bells are operated directly from the office. Of the fire-bells, there is one of 4,500 pounds weight, four of 2,000 pounds, one of 800 pounds and two of 300 pounds. A wire has been run into and rings a gong in the engineer's room at the American Sugar Refinery at Clark's Point, to apprise the officers and crew of the fire-boat of the existence of a fire. Extensions have also been run to the residence of the fire sergeant and of certain other officers; also to the headquarters of the Fire Underwriters' Patrol. The superintendent has also invented and put into use a device for preventing interruptions of a circuit by the sagging of wires from any cause until they come in contact with other transverse wires. The expenses of the department during the year, including salaries, amounted to $16,399.12. The total appropriation allowed was $17,100, of which there was a balance of $700 returned to the general fund. There was received from house-movers during the year and turned into the general fund $49.60. During the fiscal year the smallest number of alarms in any one month was fourteen (in October, 1886), and the largest number fifty-two (in July, 1886). The report concludes with the following recommendation:

"There is now being operated in this city a private system of fire-alarm gongs. Connection is made by a contact-maker in large gongs of the several companies and branch circuits radiating therefrom, upon which small gongs are placed in the residences of the "call" members of the Fire Department. The alarm, when struck at the company's headquarters, is transmitted over these lines, which are operated by independent batteries placed in the various houses of the department. These lines in no wise interfere with the working of the main fire-alarm circuits, being separate and distinct therefrom. The electromotive force consists of a few cells—the gongs 4-inch direct-acting. That this method of announcing an alarm to the "call" members of the Fire Department is considered by the President of the Board of Fire Commissioners to be a valuable adjunct to the department I have not the slightest doubt, and would freely co-operate in any plan whereby I could facilitate the notification of an alarm to those members of the Fire Department who are summoned to their duties from the workshop or fireside. I therefore recommend that the existing plant, by newly constructed circuits, be maintained by the city government and incorporated into this department, thereby guaranteeing to the Fire Department that reliability which is afforded them over the regular wires."

The report closes with a request for the services of an additional lineman should the foregoing recommendation be adopted.

BIDS FOR CHICAGO RIVER ELECTRIC LIGHT PLANT.

	Electric and steam plant.	Patterson cable.	Kerite cable.	Standard cable.	Lamp fixture.	Coal consumption per h. p. per hour.....	Amperes.....	Volts.	Tension.....	Electric plant.	Total cost with 10 miles circuit.
Excelsior, Ide or Payne..	$12,745.00	$2,100.00	$2,100.00	.....	$10.00 ea.	5.26	10	45	high.	.....	$34,745.00
F. Wayne Jenney, Williams	.....	.....	.....	.....	$2,000.00	3.75	20	30	low.	.....	29,500.00
Brush, Payne	13,560.00	.....	2,350.00	.....	.....	3.25	9½	45	high.	$7,760.00	37,060.00
" Ide	13,182.50	.....	2,350.00	.....	.....	5.	9½	45	high.	.....	36,682.00
" Williams	12,847.00	.....	2,350.00	.....	.....	3.75	9½	45	high.	.....	36,347,00
W. Elec. Co., Russell	11,045.00	1,825.00	.....	.....	.....	4.	18	25	low.	.....	29,295.00
" Buckeye	11,399 00	1,825.00	.....	.....	.....	4.	18	25	low.	.....	29,649.00
" Williams	11,862 00	1,825.00	.....	.....	.....	3.75	18	25	low.	.....	30,112.00
" Payne	12,575.00	1,825.00	.....	.....	.....	3.75	18	25	low.	.....	30,825.00
U. S. Co., or Williams	14,575.60	.....	1,999.00	.....	.....	5.00	18	30	low.	.....	34,565.00
Cowie & Van Denburg (Sperry system)	Bid on electric plant only.			.....	.....	....	....	....	.....	6,500.00	.....
Chi. Arc. L. & Power Co., Buckeye	.....	.....	.....	.....	.....	4.5	....	....	high.	.....	35,000.00 (Cost of expert 30 days, $100.)
S. S. Badger	.....	.....	.....	.....	.....	....	96	45	high.	7,457.00	.....
Ball Elec. L. Co., Payne	15,500.00	.....	2,394.00	.....	.....	3.25	8 to 10	45 to 48	.....	.....	39,440.00
" Buckeye	14,100.00	.....	2,394.00	.....	.....	4.	8 to 10	45 to 48	.....	.....	38,040.00
" Reynolds	15,900.00	.....	2,394.00	.....	.....	3.¾	8 to 10	45 to 48	.....	.....	39,840.00
" Williams	14,700.00	.....	2,394.00	.....	.....	4.60	8 to 10	45 to 48	.....	.....	38,640.00

THE TELEGRAPH.

Texas.—Telegraph construction in Texas, in connection with railroad lines, calls for 5,000 miles of new wire, which there is difficulty in obtaining with promptness. The existing lines are taxed with business beyond their capacity.

Telegraphy and Finger Nails.—It is reported that two telegraph operators, a male and female, both otherwise healthy subjects, are being treated in Berlin for a newly developed ailment, namely, the dropping off one after another of the finger nails. Professor Mendal considers this curious affection as the result of the constant jar caused by hammering and pushing with the finger ends in working the Morse system of telegraphy.

THE TELEPHONE.

Germany.—Telephone service between Hamburg and Berlin, a distance of 150 miles, has now been opened to the public.

The Telephone in China.—A Pekin correspondent of the New York *Sun* says: An American party have arrived at Tientsin, and are negotiating for a concession to introduce the telephone, and hope to succeed, but as the telephone is no novelty here, and the Chinese imperial telegraphs are under competent control, who can manage telephones as well as telegraphs, it is not altogether certain that the Americans will be able to make a success of their present venture. Even if they get a contract, it is not likely to be a very remunerative one, for the simple reason that there is but a limited class to use it.

THE ELECTRIC LIGHT.

Bessemer, Ala.—It is said that a Brush plant is to be installed at Bessemer.

Shelby, N. C.—The Belmont Mill Company proposes to put in an electric light plant.

Hot Springs, Ark.—Miller, Stearns & Co. are putting up a building 33 × 184 which will require an electric light outfit.

Jackson, Tenn.—Mr. W. A. Settle, of Clarksville, has now closed a contract for putting up a plant at Jackson and begins work at once.

Tallapoosa, Ga.—The Tallapoosa Electric Light Company will put in a plant in the course of the next six months, but has not yet decided upon system or cost.

China.—It is reported from China that the firm of Russell & Company—an English house—have secured a contract for an electric light plant for the capital of Formosa.

Tacoma, W. T.—The Tacoma Light and Water Company, J. H. Houghton, secretary, is now operating a 50 light American arc dynamo and one 160-light Edison municipal machine.

Graham, N. C.—Mr. L. B. Holt wishes bids on an electric light plant to illuminate a cotton mill 300 × 50 feet, with basement 150 × 50 feet, mill to contain 203 looms and 4,000 spindles.

Clyde, Kan.—The Clyde Thomson-Houston Electric Light and Power Company started its station on July 20, furnishing both arc and incandescent lights. Mr. J. Brown is the president and manager and Mr. Charles E. Hart the superintendent.

Robertsville Falls, Conn.—The contract has been made with a Bridgeport party to build the dam for the Electric Light Company, Robertsville Falls, where the company will put up a building with a 240 h. p. turbine water-wheel to run the dynamos.

Cheyenne, Wyo.—Mr. E. P. Roberts, of the Brush-Swan Company, is running for day service 310 Brush storage cells of 50 ampère hours' capacity and 434 cells of 100 ampère hours.

Selma, Ala.—The Selma Gas and Electric Light Company is now running one 50 light and two 30 light arc Thomson-Houston machines. It receives $10 per month for 2,000 c. p. city lights and 40 cents per night for commercial lights, but thinks these rates are too low. Mr. H. Harthan is the manager.

Geneva, N. Y.—Work on the building of the Brush Electric Light Company just south of the Franklin House is progressing rapidly. The foundation walls are about completed and carpenters are preparing to perform their share of the work. When this building is completed it will be a model of convenience. In the first place it is large enough to accommodate such boilers, engines, dynamos and apparatus as may be necessary to furnish sufficient private and public lighting, and in addition leave ample room for increasing the power of the plant at any time without crowding. The building proper will be divided into three apartments. The east department will contain the boilers and coal bunks. This will be separated from the balance of the building by a thick brick partition wall. The second or middle apartment will contain the engines and dynamos, five in number, besides testing lamps, etc. The west apartment will contain the company's offices, testing room, storage room, etc. Every modern convenience will be provided and everything will be as "snug as a bug in a rug." Mr. Charles H. Avery is superintendent of the plant.—*Geneva Gazette.*

APPLICATIONS OF POWER.

In Spain.—An electric tramway is being built between Bilbao and Santurce.

Ottawa, Kan.—The Ottawa Electric Light and Power Company has it in contemplation to run motors on its lighting circuits.

Portland, Ore.—The U. S. Electric Lighting and Power Company, of Portland, intends to add motors to its business as soon as possible. Mr. P. F. Morey is the superintendent.

Wheeling, W. Va.—The Wheeling Railway Co., capital stock $10,000, has been incorporated by N. Hester, J. M.

Sweeney, E. W. Dunaway and others to build an electrical street railway.

Canon City, Col.—The Canon Thomson-Houston Company hopes to introduce some motors at an early date.

New York City.—At the last meeting of the New York Rapid Transit Commission, Mr. J. M. Hannah presented a plan for an elevated railway commencing at the Battery and running through Water street to Broad, to Nassau, across Printing House square to Elm, to Crosby, to Lafayette place, to Fourth avenue, to Forty-second street. The motive power is to be cable or electricity, and the plan of the road is the same as that adopted by what is known as the "Broadway Transit Company," with which Mr. O. B. Potter is said to be connected. J. M. Hannah is the inventor, and the improvements claimed for the plan over elevated roads now operated in this city are less obstruction to the street and the impossibility of cars jumping the track. The application was placed on file.

A Handy Breeze.—The New Brunswick, N. J., *Home News*, which is printing by electricity, has the following: "We are not taking so much interest in the hot weather to-day, because we have a private breeze blowing over our left shoulder that is exhillerating to the last degree. It is made by a "C. C." electric motor with a large fan wheel attached, revolving at a speed of about 1,250 revolutions per minute, and producing a zephyr that only needs a stale clam and a pinch of salt to establish a first class seaside resort on one end of our table. For this luxury we are indebted to Mr. W. S. Howell, Superintendent of the Electric Illuminating and Power Company's works. The whole apparatus is not larger than a good sized table cruet stand and can be set wherever it will do the most good."

PERSONALS.

Mr. A. Pfannkuche, whose system of distribution with high to low tension current we described lately, is on a trip to Europe.

Mr. Wilfrid H. Fleming, a brother of Dr. Fleming, and in practice as an electrical engineer in Liverpool, is now visiting this country, with the object of studying methods and apparatus in vogue here.

Mr. F. J. Sprague has been seriously ill, overwork having brought on a bad attack of fever. The rapid accumulation of business induced him to take undue risks, and though latterly he restricted himself chiefly to factory and experimental details, he is paying the penalty of too close attention to business. His early convalescence is hoped for.

MISCELLANEOUS NOTES.

Cleveland, O.—The city has legislative authority to expend $500,000 in the construction of electric subways, and the necessary ordinances and resolutions are being prepared for the city council.

The Graphophone has been on exhibition before the Business Educators' Association at Milwaukee by Mr. A. Devine, the well known Congressional stenographer, who states that he intends this winter to dictate his notes to it for subsequent transmission by amanuenses. He considers it impossible, however, to use the machine, or any other like it, for the direct work of reporting debates and proceedings. He sees a wide field of use for it in offices.

A Fine Display Promised.—At the quarterly meeting of the American Institute at Clinton Hall last week ex-Judge R. H. Shannon announced for the board of managers that the next fair of the Institute will open Sept. 28 and continue into December. The chief featuree of the exhibition will be the display of electrical machinery. No prizes will be offered. The chief manufacturers of electrical appliances in the country have promised to take almost half the space in the big Third avenue building. The other features of the fair have not yet been arranged, but several interesting novelties are under consideration.

Smoke and Gas Consuming Furnaces.—The Foundry and Machine Department Harrisburg Car Manufacturing Company, Harrisburg, Pa., calls attention to its Weitmyer patent smoke and gas consuming furnace, with which it is claimed that superior results can be obtained with any and all kinds of combustible materials. In this furnace, all the air for combustion is taken in at the rear of the setting and under the flame bed, becoming heated before being introduced to furnace, thus promoting combustion. A portion of the heated air, after passing through bridge-wall arches into ash pit, is allowed to pass to top of bridge-wall, through suitable passages; this air supplying the necessary oxygen to ignite the gases, which would otherwise escape unconsumed. It will, also, with the least possible care on the part of the fireman, entirely consume all smoke. The front ash-pit, or draught door, is always kept closed, so that no cold air can rush through any exposed part of grate to the detriment of boiler, and of proper combustion. The draught regulation is always attended to by the damper in stack or damper chamber. The works have put a Weitmyer in their own shops and have since January last placed 20 under boilers in Harrisburg alone.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Shaw & Geary, the manufacturers of and dealers in electrics appliances, 53 and 55 North Seventh street, Philadelphia, have issued this month a very neat and comprehensive catalogue of 39 pages, and devoted to a large extent to their own productions, such as electric gas lighting apparatus, electric door springs, window springs, floor pushes, drops, binding posts, etc. Mr. J. A. Davis is the electrician of the firm.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

Aug. 2, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	25	35
Am. Tel. & Cable	70½	73
Cen. & So. Am.	.....	.....
*Com. Tel	.....	.....
*Gold & Stock	.....	.....
*Inter. Ocean Tel.	.....	.....
N. Y. Mutual	75	80
Pac. & Atl.	.....	.....
*Postal T. & C.	20	30
South. & Atl.	.....	.....
W. U. Tel.	70¼	70¼
W. U. Scrip.	.....	.....
W. U. Bonds	116½	.....
Mut. U. Bonds	85	85½
TELEPHONE.		
Am. Bell	201	202
Am. Speaking	110	120
Erie	31¾	32
*Hudson River	.....	58

TELEPHONE.	Bid.	Asked.
Mexican	1¼	1½
*N. Y. & N. J.	.....	90
N. Y. & Pa.	.....	.....
New England	42	42½
*Southern Bell.	125	135
ELECTRIC LIGHT.		
*Am. Electric	.....	.....
*Brush	.....	.....
*Brush Ill.	.....	.....
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	.....	.....
*Edison Ill	.....	.....
*Edison Isolated	.....	.....
*United States	.....	.....
*U. S. Ill.	.....	.....
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

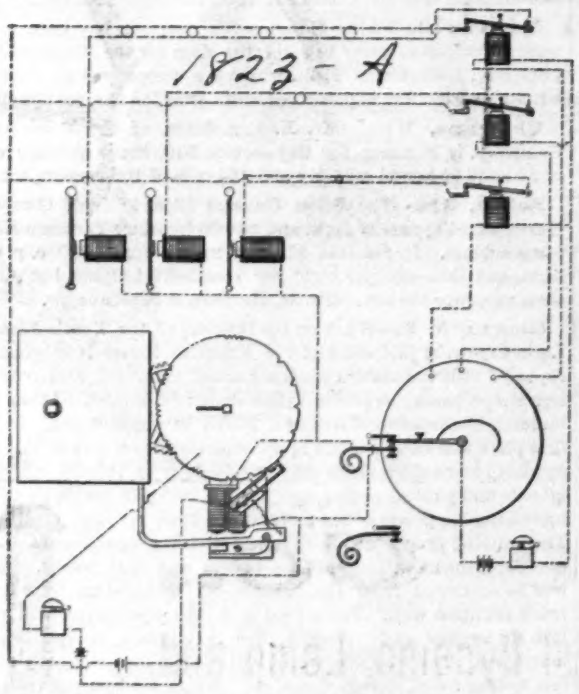
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JULY 26, 1887.

367,042. Acoustic Telegraph; J. H. Irwin, of Philadelphia, Pa. Application filed June 4, 1879. Devices are employed to make the instrument self-regulating with reference to fluctuations in the battery tension by means of an electro-magnectic regulator in a short or local battery circuit.

367,069. Electric Locomotive; E. S. Shaw, of Cambridge, Mass. Application filed June 3, 1886. A novel manner of mounting a motor on the truck so that short turns may be easily made. The invention also embraces means for best applying the power from the motor to the car axle. See illustration.

367,089. Armature for Dynamo-Electric Machines; M. J. Wightman and O. Urban, of Hartford, Conn. Application filed Aug. 19, 1886. Means for more effectually in-u



367,205. TESTING SYSTEM.

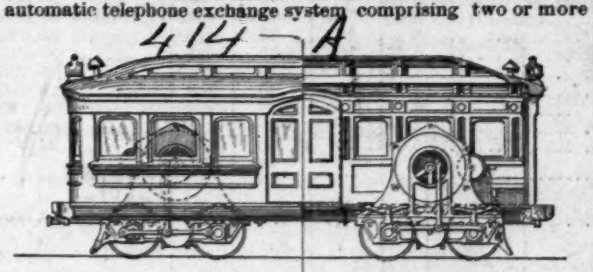
lating and ventilating the coils of an armature. For illustrated description see THE ELECTRICAL WORLD, July 23, 1887.

(1) **367,081. Dash Pot for Arc Lamp;** (2) **367,082. Switch and Automatic Cut-out;** M. J. Wightman and H. Lemp, of Hartford, Conn., Assignors to the Schuyler Electric Manufacturing Co. of Connecticut. Applications filed Aug. 19, 1886. (1) One cylinder within the other, one acting as a piston and having a depression and perforation, the latter serving as a valve and being controlled by a ball. (2) Consists of two pivoted levers, a spring insulated from and connected with said levers on opposite sides of the fulcra, a handle on one of said levers, spring jaws mounted on the other for making contact with the former, and electrical connections.

367,164. Insulator; H. K. Ruger, of Bay St. Louis, Miss. Application filed April 13, 1887. A novel self-tying insulator, which excludes the moisture, and is simple and cheap to manufacture.

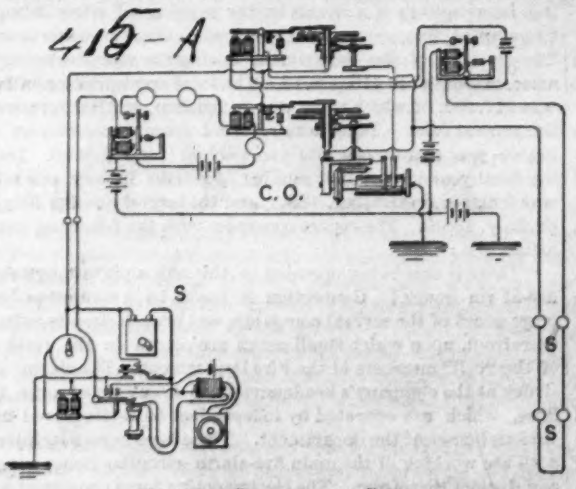
367,205. Electric Test System; J. W. Frost, of Rochester, N. Y. Application filed Sept. 25, 1886. The object is to provide such a test for fire-alarm circuits that an inspector may, by simply operating one or two switches, ascertain if the circuits and apparatus of the alarm system are in order. (See illustration.)

367,219. System of Telephonic Intercommunication; J. A. McCoy, of Medford, Mass. Application filed Jan. 29, 1887. The first claim describes the invention as follows: An automatic telephone exchange system comprising two or more



367,069. ELECTRIC LOCOMOTIVE.

sub-station lines converging, for the purpose of intercommunication, to a central station, a series of conducting arms normally rotating continuously or periodically at the central station in synchronism with one another, each constituting a terminal of one of the lines, electro-magnetic connecting apparatus for each line, whereby the said line is enabled to stop the rotating arms of the several lines each in its own time, and thereby to selectively connect itself with any other line, and reactive reciprocal connecting devices whereby the other line, thus connected, is caused to separately stop the arm of the line initiating the connecting, and to connect itself thereto independent of the first connection. An indicator at each sub-station indicat-



367,219. TELEPHONIC SYSTEM.

ing the proper time for connecting with any other line, and a circuit-changing device operated by removing the receiving telephone from its support and adapted to change the electrical condition of the circuit and thereupon to actuate the said central station electro-magnetic connecting apparatus. See illustration.

367,270. Electrically Actuated Vibrator; F. B. Colman, of New York, N. Y. Application filed Nov. 23, 1886. A vibrator supported at both ends, a magnet for actuating it and devices for straining it to any desired tension.

367,294. Galvanic Battery; H. I. Harris, of Islington, County of Middlesex, Assignor to John J. Walsh, of London, Eng. Application filed June 6, 1887. A wooden partitioned cell, the compartments carrying a porous cup of novel construction.

367,323. Fire Extinguishers; C. H. Shaffer, of Rockford, Ill., Assignor of one-half to Jones, Woodruff & Co., of same place. Application filed Sept. 20, 1886. A closed electric circuit in connection with a thermostat is used to control the valves in a dry pipe system.

367,332. Means for Individually Controlling a Number of Devices of Electricity; C. Baxter, of Brooklyn, N. Y. Application filed Jan. 21, 1887. The invention consists in the employment of magnets arranged in two sets and in controlling each of the several devices by a pair of magnets, one from each set, the pairs employed in controlling the several devices being different for each.

367,341. Electric Smelling Bottle; L. B. Fuller, of Chicago, Ill., Assignor, of one-half to William S. Mitchell, of same place. Application filed March 7, 1887. A small battery is

367,350. FIRE EXTINGUISHING APPARATUS.

inserted in a bottle containing the medicinal fluid for the purpose of volatilizing the same.

367,348. Lightning Rod Brace; L. L. Mast, of West Milton, Assignor of one-half to W. J. Mast, of same place. Application filed Dec. 23, 1886. Three rods twisted together at the top and forming a tripod at the lower end. The eyes for the insulators are bent from one of the rods.

367,350. Apparatus for Extinguishing Fires on Railroad Trains; J. F. McLaughlin, of Philadelphia, Pa. Application filed March 22, 1887. By this apparatus the simple operation of a push button or other closing device will so operate valves as to shut off the supply of gas to the burners or extinguish the fires. See illustration.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.